AUGUST, 1916

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SEE PAGE 237

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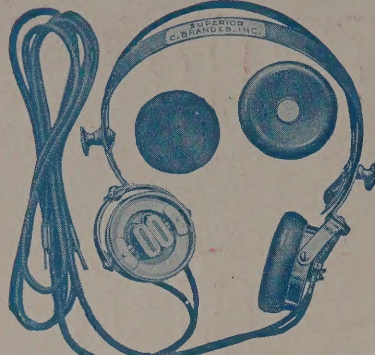

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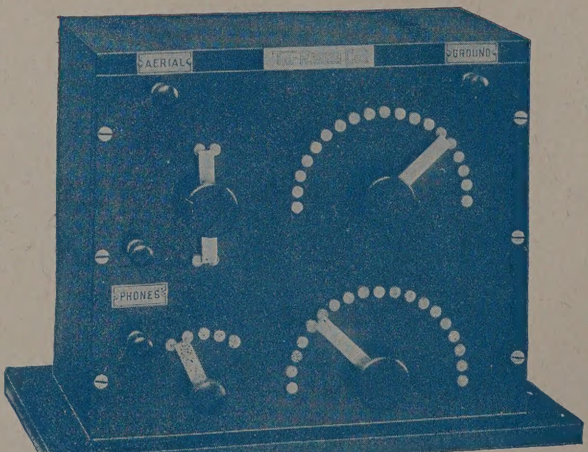

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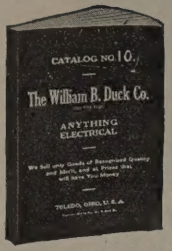
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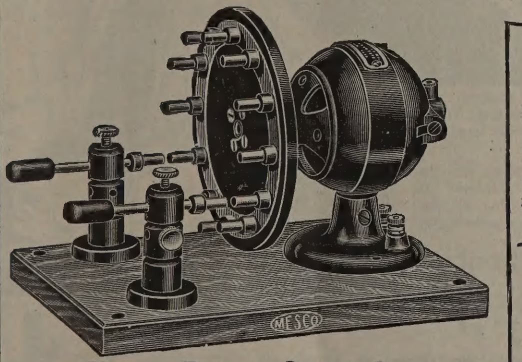

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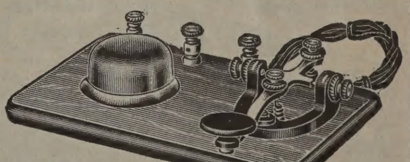

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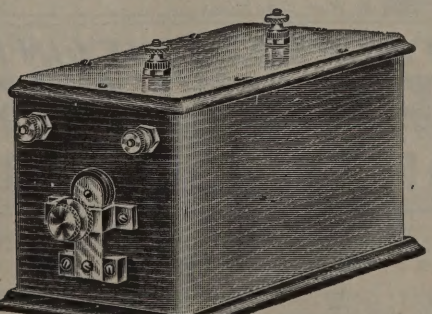

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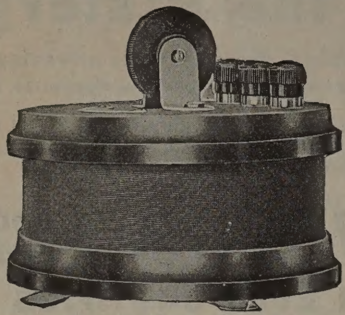

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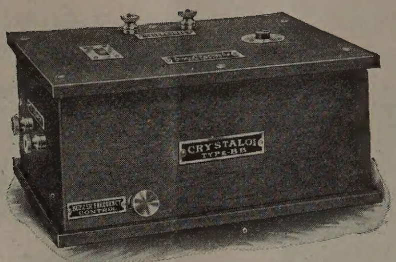

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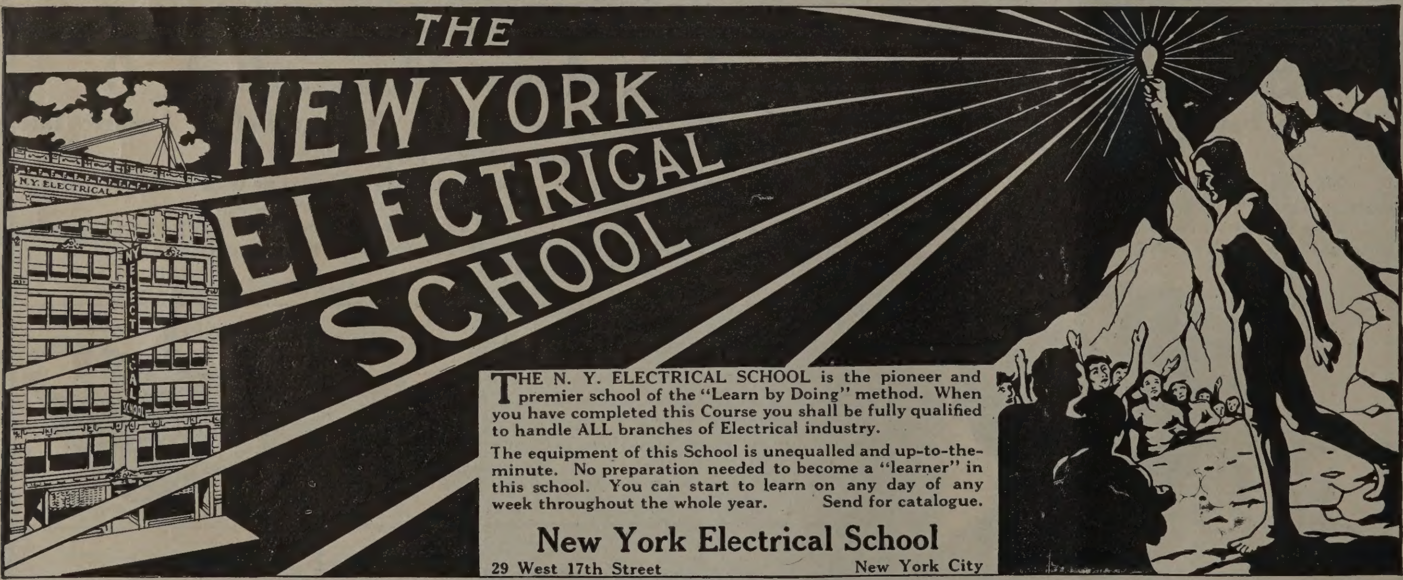

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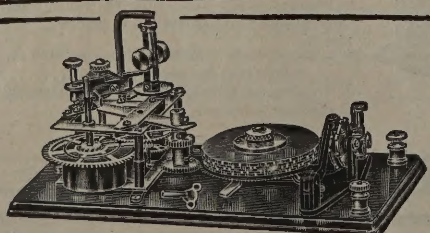

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The Perversity of Things

THIS is by no means a new subject. Much has been said and written about the recalcitrant behavior of things in general toward us humans. Much remains to be said and written. Very much remains to be explained.

Of all individuals, the experimenter, perhaps, suffers most under the tyranny of the inanimate things and it happens not infrequently that he succumbs to their wiles and to their devilish snares.

Let us take an everyday case, familiar to every experimenter, worthy of the name. You have planned the construction of a certain instrument and you know just how to go about making it.

You have shaped the wooden base which is now ready to be drilled for its several holes. You have laid out the holes on the base and while doing so you have broken the point of your pencil twice. This has caused you some annoyance. After you have drilled every hole but one, you break the only two drills you have in the attempt to drill through a knot! Of course *that* hole just had to come on a knot! But you must have that hole. What is there to do? In the absence of the drill, a bright idea strikes you. The hole will be drilled without the drill! Therefore you take a nail, heat it red hot, and after much effort the hole is finally well under way. As the process is slow and weary, you decide not to burn the hole all the way through. So when the nail has penetrated three-quarters through the board you take recourse to the hammer, intending to drive the nail through the remaining portion of the wood. In this you are successful indeed—but, alas, with the result that the entire base is split in two! Another base is made now and everything seems to run smoothly, including the holes. After the base is finished you give it several good coats of shellac and it is then placed in the sun to dry, while you go to lunch. On your return you look at the base. Somehow it does not look the same. Sure enough—it has begun to warp badly already and you know that by tomorrow morning it will be bent into almost a semi-circle.

By this time you are angry clear through and you slam the base into the furnace, accompanying the action by much profanity. You mutter of "Hoodoo" and "Hard luck," but if you are a true dyed-in-the-wool experimenter, you will be working on a third base before long. You do not fare much better with the balance of the work. Everything you touch seems to be "hoodooed." Screws don't fit, nuts will not go on their respective screws, the brass casting cannot be fitted for hours at a time, you can't seem to drill or tap a hole without snapping off either the drill or the tap. To add insult to injury, just when the instrument is about to be completed, the screwdriver slips and makes a nasty gash in your left hand. This, of course, puts you out of action for the time being and you are, indeed, worthy of our admiration if you do not let loose a "blue streak" of English not found in Webster's unabridged dictionary!

Now let us analyze this seeming perversity of things. Why do inanimate things act thus? Why does the eternal wisdom of nature, seemingly always interpose obstacles in his way whenever man desires to invent or construct a certain new thing?

The answer is that it does not. It is not the things that are perverse, it is ourselves who make them seem perverse.

In our example just mentioned, it was not the fault of the base which kept you from completing it. It was purely your lack of forethought, and mostly your impatience that caused all your trouble. For if you had used a carpenter's pencil, instead of a frail drafting pencil, the point would assuredly not have broken twice. Simply lack of attention here. Also, had you turned the base around the other way, your drill would, in all probability, not have struck the knot hole. Again lack of attention. Once you knew that you had not the proper tools to drill holes through a hard knot, you had no right to attempt the work in spite of it. Forethought would have told you the inevitable result. This holds true for the second base. Common sense should have told you not to use "green" wood for an instrument base; painting shellac on one side of it, taught you a graphic lesson.

And so it goes all the way through. So it has gone for aeons and centuries. Man always stands ready to blame inanimate things for his blunders; everything is blamed on the perversity of things, when it should be blamed on the perversity of man.

It took the human race several million years to construct an automobile. The material, the things, existed for millions of years long before the human race was heard of; it was not for lack of things that the first automobile was not built sooner. It was for the lack of man's intelligence. To-day, the same man with a little acquired intelligence and a little acquired experience turns out several thousand automobiles each working day—no perversity of things here.

Summing it up the failure of most experimenters and workers who do not accomplish anything can usually be directly traced to their lack of knowledge of inanimate things. At best few people thoroughly understand materials. Few people can tell offhand what certain materials will do and what they cannot do, under conditions to which they have never been subjected. Men like Faraday and Edison have this exceptional instinct developed in a high degree. They know intuitively what a certain metal will do in a vacuum when subjected to a high potential electrical discharge. With most other workers it is a case of long experience and intimate contact with things that gives them the true insight into their characteristics. Furthermore, the man who accomplishes things is the man who doesn't lose his temper and who doesn't get impatient. The successful experimenter's motto should be: *Patience.*

If people would only stop to think how infinitely little we know about everything about us, and how thoughtless we are in our relations to all inanimate things, we would not be so apt to complain about the fabled Perversity of Things.

H. GERNSBACK.

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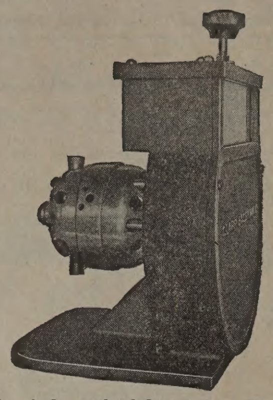

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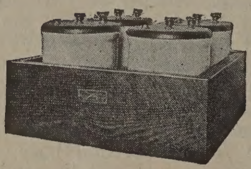

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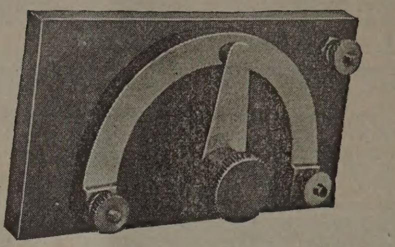

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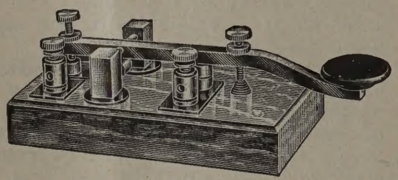

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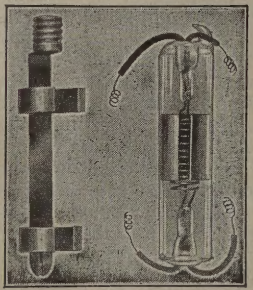

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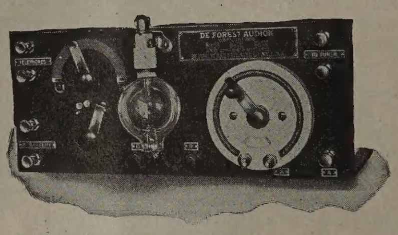

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THE ELECTRICAL EXPERIMENTER

H. GERNSBACK EDITOR
H. W. SECOR ASSOCIATE EDITOR

Vol. IV. Whole No. 40 AUGUST, 1916 Number 4

Electricity Now Rids Trees and Plants of Insects

EVERY year there is a loss of hundreds of thousands of dollars to the American farmer, and, in fact to farmers everywhere, occasioned by the myriads of insects, worms and their larvae attacking either the plants themselves or their roots. Many different kinds of poisons as well as chemicals have been tried out, such as those which are diluted in water and then sprayed on the growing plants, and again those forms of insecticide, which are simply blown on the plants in the form of powder. There is also a method widely employed whereby bi-sulphide of carbon is poured into the holes made in the soil around the roots of the plants. A common spraying solution used for this work is based on the use of arsenites; gases have also been used such as hydrocyanide.

It has remained, however, for Mr. Isadore Kitsee, a well-known inventor of Philadelphia, to perfect and patent an electrical system intended for the protection of trees and plants, by killing the larvae, eggs, etc.

The cost of this system is said to be small and the means of applying it comparatively simple. The underlying principle of Mr. Kitsee's invention consists in the generating of the insecticide, which is preferably in the form of free gas, or a gas evolved from a solution with the aid of an electric current and applying the gas, or gas containing solution in a nascent state, to the soil or plant infested with the insects, their larvae or eggs. Either the plant may be treated by this method, or the soil may be freed from the obnoxious insects.

The illustration here shows how the process is installed on a farm. The electric feed wires from the dynamo plant or from the local commercial lighting circuit are run along the side of the fields which may require treatment at any time. Both positive and negative feed wires are run along both sides of the field, so that the portable spraying outfit may be operated wherever desired. The electric motor on this outfit requires, of course, current from both negative and positive supply wires. Where it is required for a comparatively small area of soil in which the plants grow, this soil may be impregnated with the solution carrying the insecticide element, and this solution is afterwards electrolyzed with the aid of an electric current, by simply inserting metallic electrodes or plates around the area to be purified, the electrodes being connected to the positive and negative supply wires as the accompanying illustration shows. When a fairly large area is to be treated with this process of insect extermination, it then becomes preferable to dig trenches on at least two sides of the area, filling them with a solution to be electrolyzed or decomposed by the passage of an electric current through it. It is also a very good idea, when possible, to impregnate the

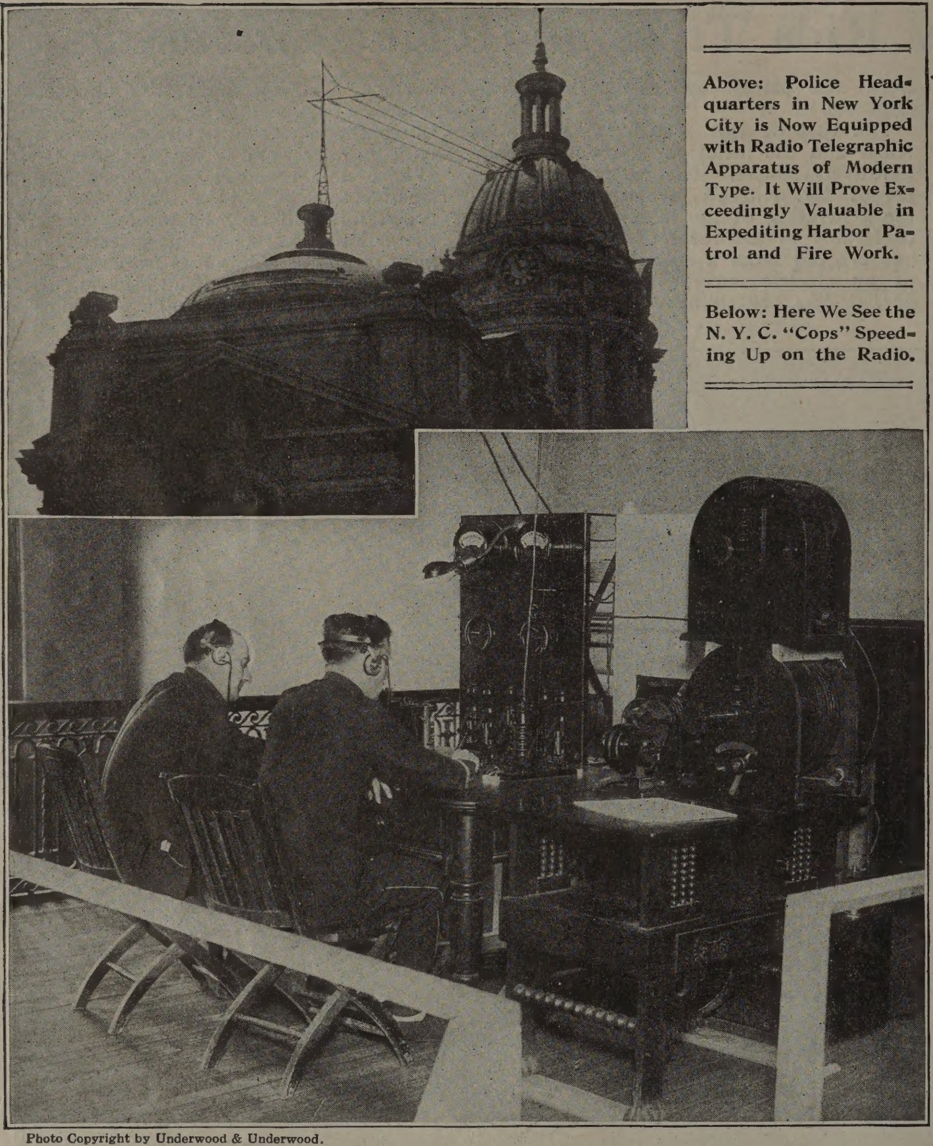
(*Continued on page 286*)

A New Electrical Method of Ridding Trees and Plants of Insects and Their Larvae. A Salt or Other Solution Is Placed in the Ground and Then Decomposed by Passing an Electric Current Thru the Earth Between Oppositely Charged Metallic Plates. Said to be Reasonable in Cost and Efficacious in Results.

Radio in N. Y. Police Preparedness

The latest move in preparedness is that of the Police Department, started by Commissioner Arthur Woods of New York City.

Commissioner Woods has long been trying to bring about some sort of preparedness league in the police department so that it could act immediately in case of emergency. Finally he appointed a committee of three, consisting of Chief Max F. Schmittberger, Inspector John Daly and Inspector Frank Morris. These three men were to look into the matter very carefully and to ascertain the method most suitable for communication in case that other methods of communication, such as the telegraph and telephone, should fail, due perhaps to an earthquake or large conflagration.



Above: Police Headquarters in New York City is Now Equipped with Radio Telegraphic Apparatus of Modern Type. It Will Prove Exceedingly Valuable in Expediting Harbor Patrol and Fire Work.

Below: Here We See the N. Y. C. "Cops" Speeding Up on the Radio.

Photo Copyright by Underwood & Underwood.

After a lengthy consideration and investigation, it was decided by the committee that radio telegraphy would serve the best. Work was immediately begun, and a set of transmitting and receiving instruments were purchased.

The transmitter consists of a standard one kilowatt set, comprising a motor-generator, closed core transformer, a quenched spark gap, cooled by means of a motor-driven fan, and an oscillation transformer. This consists of a primary and secondary of copper ribbon, supported on insulating strips. The coupling between the coils is adjusted by the large circular knob at the front panel. The inductance of the primary is varied by turning the lower switch. The aerial loading coil is mounted above the transformer and the capacity is composed of three Leyden jars, placed behind the oscillation transformer. These are supported on an insulating frame. The motor and generator are controlled from the switchboard.

The receiving instruments are located at the left, the cabinet containing a loose coupled tuner, loading coil, two variable condensers, special type crystal detector, and two sets of telephone receivers. The aerial switch at the right, is of heavy construction.

The aerial used with this set is 185 feet high and 100 feet long, composed of four stranded phosphor bronze wires. One end is supported by a 35-foot latticed pole, while the other end is guyed to the tower. Although this antenna appears small in size, it has a natural wave length of 300 meters, while the transmitter is tuned to 450 meters.

This outfit has been in service but a short length of time, but excellent work has been performed with it. The station has a transmitting range of 500 to 800 miles, while the receiving instruments have a receiving range of 2,000 miles. The station is under full control of Sergeant Charles E. Pearce, who is also instructing a number of officers in order to meet the requirements of radio service for the police department.

This is perhaps the first radio plant ever installed for official police service work in the world and it is expected that similar or better stations will be erected at the different police stations throughout the five boroughs. In this way the department will keep a constant watch on affairs which may occur in places where the telegraph and telephone cannot be used, as for instance during a riot or fight on a vessel located in the harbor, or in case of a serious conflagration. Also if the telegraph and telephone lines were out of order communication would be still going on with the aid of the radio apparatus. This is one of the best ideas brought out lately by any public department in any city.

WIRELESS AND PREPAREDNESS.

The importance of radio communication in war is so great and so manifest that any attempts to support the proposition by argument would be supererogatory. Moreover, the nation which shall have brought the development of radio-telegraphy to the highest pitch before the outbreak of war will, other things being equal, possess a great advantage over its enemies, says the *Electrical World* editorially, especially in so far as relates to long-distance communication with and between its fleets at sea.

Obviously, therefore, the best method of being prepared against hostilities in the field of radio communication is to have plans prepared for the prompt occupation and utilization of all coast radio stations at the first outbreak. There should, on the declaration of martial law, be complete and speedy mobilization of all radio activities by the military and naval forces. But, on the other hand, there should be the minimum of interference by the government with commercial radio communication during times of peace. Radio communication is still a very young art. It hardly goes back to the beginning of this century. Much capital has been honestly invested in it. There is an enormous field for the development of the range, precision, cheapening and improvement of radio signaling. The best way to encourage that development is to give fair play, and free play, to all inventors, business men and industrial forces, whereby, for gain and commercial advantage, it may be possible to enlist the interest and industry of the greatest number of workers in this field.

On the other hand, the surest way to discourage the art, science and engineering of radio communication is to convert the whole field, during peace times, into a monopoly of some department of the government, civil or military. To place all radio signaling in the hands of, say, the navy department, during times of peace, would be to hamper all progress and hinder all development, thus tending to keep America in the background of radio communication, for any purpose peaceful or warlike. It goes without saying, however, that such officers are necessarily too busy with their immediate routine duties to spend much time and money in protracted or extensive invention and development in radio engineering. Any monopoly of a great business inevitably leads to lack of competition, to lack of stimulus and eventually to stagnation. Progress comes from holding open the avenues of success to individual talents, industry and enterprise.

Let us hope that the progress and wealth of the nation, in so important and all-pervading a field as radio communication, in time of peace may be fostered by keeping it out of the deadening clutch of government monopoly.

Putting Incandescent Lamps Thru the Third Degree

THE importance of standardizing lighting appliances may be realized when it is known that over 160,000,000 incandescent lamps and 75,000,000 gas mantles are used yearly in this country alone. The average lighting bill is about one per cent of the annual income of the average person or corporation, and this tends to increase as time goes on. On this account, it has become necessary to provide exact methods for measuring candle-power and the rate of burning of the various types of lamps now in use.

The Electrical Testing Laboratories in New York City maintain a very elaborate equipment for commercial lamp testing. The tests are conducted by a corps of engineers who are specialists in measurements of this kind. Tests are made of all types of lamps, from paraffin or tallow candles to the latest types of electric and gas lamps.

No practicable instrument has ever been invented which will measure light mechanically, so all such measurements are made by comparing the lamp to be measured with a lamp whose candle-power is already known, by means of a very sensitive screen or prism in which the light from the lamp to be measured and the light from the standard lamp are compared. The relative distances between lamps and screen are varied until the illumination from both lamps is apparently equal. Then, as it is a well-known law that light varies inversely as the square of the distance of the lamp from the screen, the candle-power of the lamp to be measured can be figured from the ratio of the distances of the lamps from the screen. That is, if the standard lamp is 20 candle-power and is placed one foot from the screen, and the lamp to be measured is found to give equal illumination at four feet from the screen, this lamp will be 16 times as brilliant as the standard lamp, or 320 candle-power.

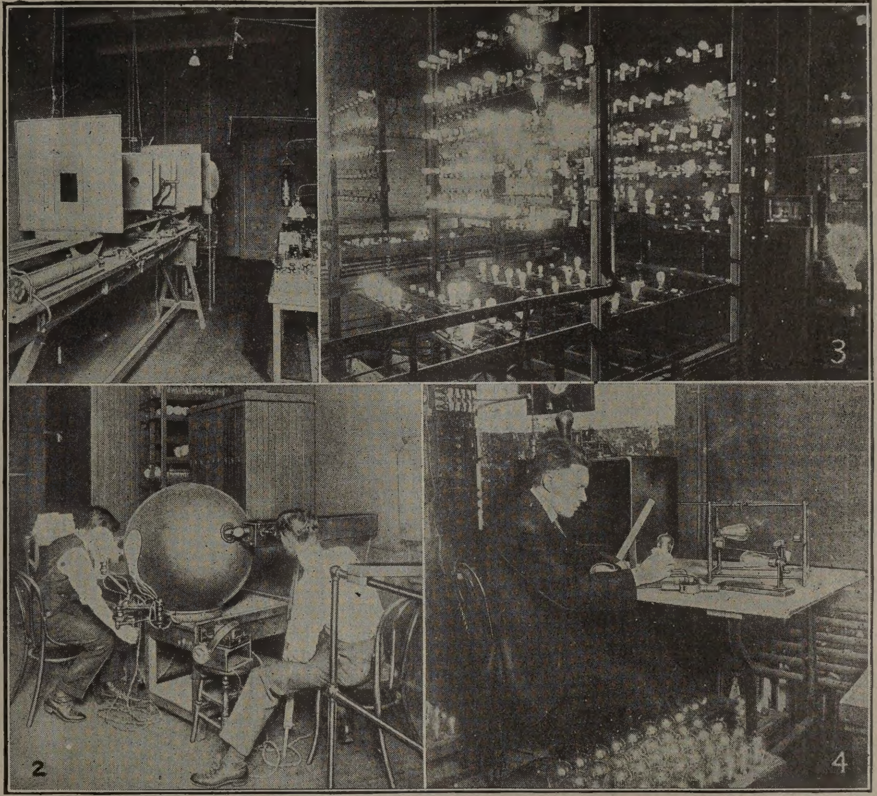


Fig. 1. Shows a Photometer for Measuring the Candle-power of Incandescent Lamps. Fig. 2 a Spherical Photometer for Similar Work. Fig. 3. "Life" Test Racks. Fig. 4. Lamp Inspector at Work.

Figure 1 shows a photometer (light meter) which is equipped for work of very high precision. This instrument is used for measuring incandescent lamps which are to be issued as standards of a candle-power. After standardization, such lamps are sold for use as standards of candle-power to laboratories, manufacturers of incandescent lamps, colleges, central stations, public service commissions, etc.

Figure 2 illustrates the photometer which is used for measuring total light-flux. All lamps vary in light production in different directions about the lamp. The sphere shown in the illustration is painted on the inside with a light diffusing paint. When the lamp to be measured is placed within the sphere, the light from the lamp is reflected back and forth by the surface of the sphere until each portion of the sphere's surface is receiving an amount of light which is proportional to the total light-flux of the lamp, so that the total flux, from which may be derived the "mean spherical candle-power" can be determined in one measurement. Other spheres are provided of varying sizes which are equipped with apparatus for measuring gas lamps, oil lamps or arc lamps. One as small as 12 inches in diameter is used for measuring telephone or miniature lamps. Another for measuring arc lamps is 80 inches in diameter.

Figure 3 is a view of a portion of the "life" testing department. This illustration shows the methods of operating incandescent lamps to determine their period of burning or life under standardized conditions. The results of life tests are used by lamp manufacturers, by large purchasers of lamps, by inventors and engineers, each in accordance with that particular phase of the lamp problem which is of particular interest and importance. Each one of the racks shown in the illustration is supplied with a definite voltage, and the various racks differ from each other by approximately one volt. By means of a small resistance coil which is placed in series with a lamp, the voltage may be regulated to one-tenth of a volt. This is very important, as the life of a tungsten filament lamp varies about 15 per cent with one per cent change in voltage, so that a small variation has a considerable effect on the accuracy of the life test.

Figure 4 depicts a lamp inspector at work. All lamps which are tested are submitted first to an inspection, so that defective lamps may be eliminated. The socket before the inspector in the illustration is connected so that a lamp may be operated at a high and a low voltage in rapid succession. The picture also shows appliances for physical testing, including the base wrench to determine if the base is tightly cemented to the lamp, a measuring device for quickly determining the dimensions of lamp parts, and a device for ascertaining the eccentricity of base mounting. An induction coil is also shown, by means of which the nature and quality of the vacuum in the bulb is determined. This may be seen on the cabinet behind the operator.

The lack of space forbids the further elaboration of this description, but when it is realized that over 20,000,000 lamps of all kinds are inspected and tested yearly under the Laboratories' supervision, and over 10,000 lamps tested to destruction in the various life tests, some measure of the importance of this work may be had.

TELEPHONE DEMONSTRATIONS AT FRANKLIN INSTITUTE.

The American Telephone & Telegraph Company gave demonstrations of transcontinental and wireless telephony at Franklin Institute, Philadelphia, Pa., May seventeenth. In the afternoon demonstrations were given by telephone and talking-moving pictures, telephony from Philadelphia to San Francisco, and wireless telephony from the Arlington tower of the Navy Department, Washington, D.C., to New York City, and thence by wire to Philadelphia. In the evening there were three 45-minute periods of demonstrations. Medals were presented to T. W. Richards, director, Wolcott Gibbs Memorial Laboratory, Harvard University; J. J. Carty, chief engineer, American Telephone & Telegraph Company, and to the American Telephone & Telegraph Company represented by President Theodore N. Vail. Dr. Richards spoke on "The Fundamental Properties of the Elements," and Mr. Carty on "The Telephone Art." Mr. Vail also made a short address.

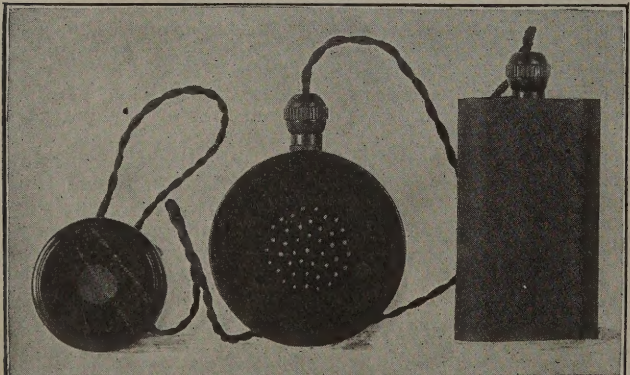
DATE OF ISSUE.—*As many of our readers have recently become unduly agitated as to when they could obtain* THE ELECTRICAL EXPERIMENTER, *we wish to state that the newsstands have the journal on sale between the fifteenth and the eighteenth of the month in the eastern part of the United States and about the twentieth of the month west of the Mississippi River. Our subscribers should be in possession of their copies at these dates. Kindly bear in mind, however, that publications are not handled with the same dispatch by the Post Office as a letter. For this reason delays are frequent, therefore kindly be patient and do not send us complaints as to non-arrival of your copy before the twenty-fifth of the month.*

AN ELECTRICALLY TIMED BANQUET.

"We have with us to-night," was a tabooed phrase at a farewell banquet tendered Guy L. Bayley and L. F. Leurey at a San Francisco cafe by mechanical and electrial engineers of the Panama-Pacific Exposition. Toastmaster J. Fitzsimmons instead notified the speakers when to talk by electricity. Each speaker, when his turn came, "felt" the inspiration to speak. The inspiration was directed by an electric battery and spark coil. Every chair about the table was wired in an electric circuit, with the switchboard at the toastmaster's plate and the speakers arose hurriedly. The event was what might have been termed a genuine Quaker gathering, with the participants in action when the "spirit moved" them.

MAKING THE DEAF HEAR ELECTRICALLY.

The wonderful development of the microphone has made it possible for electricians to utilize it in an effort to aid the deaf to hear. Of course every microphone transmitter is not adaptable for this particular work, as some of these are not sensitive enough for gathering sounds that are produced at a distance from the instrument. However, those which come under the dictagraph category are supersensitive to sounds transmitted from a considerable distance from the microphone. Such a transmitter is shown below. The construction of this instrument is practically the same as the other hypersensitive microphones, consisting simply of a light metal shell, which contains a carbon cup holding some highly polished carbon balls; the latter lightly touching a carbon diaphragm. The advantage in this design of microphone is that it overcomes the noises usually produced by other types of transmitters. This is done by building the different parts more accurately, and by a careful regulation of the current through the carbon balls. This regulation is performed by a miniature rheostat placed within the case. Our engraving shows the steps of the rheostat at the back of the transmitter. The resistor element consists of a winding of German silver wire, tapped at intervals and connected to progressive switch points. This particular sound detector is three inches in diameter and three-fourths of an inch thick. It can either be used as a portable instrument, or worn concealed in the clothing, without any marked difference in the volume of sound. The large number of holes in the transmitter permit the sounds to act readily upon the carbon diaphragm.



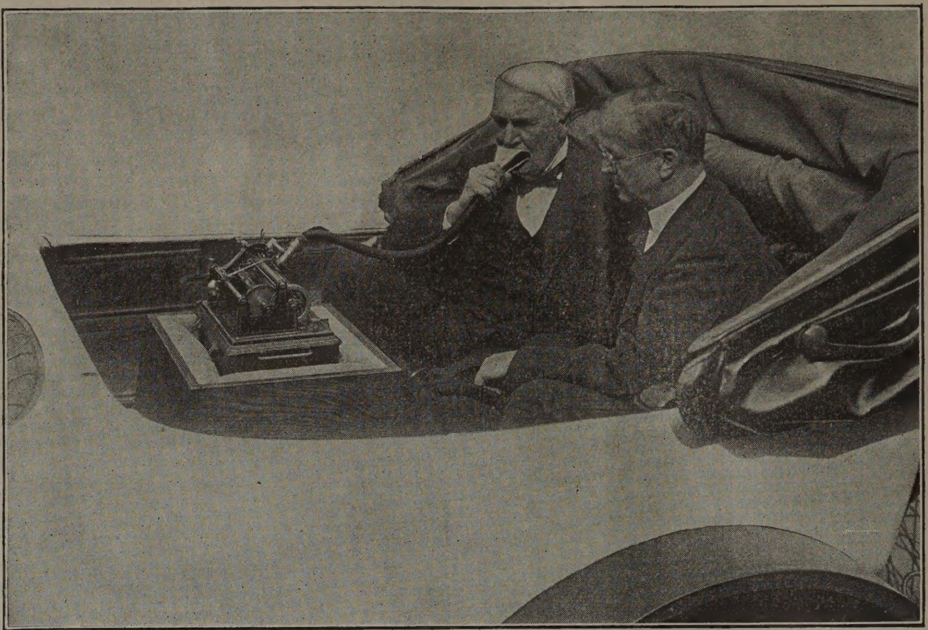
Sensitive Electric-Telephone for Use by Partially Deaf People. It Enables Them to Hear Ordinary Conversation.

The receiver, at the left of the microphone is of the standard low resistance type. Both instruments are made of aluminum, heavily coated with enamel. The electrical energy is obtained from a small, specially made dry battery, illustrated at the right of the transmitter.

These instruments will undoubtedly interest those who are defective in hearing, or those who engage in detective work.

Edison and Brisbane Try a New Time Saver

Automobiles and other modern conceptions in the mechanical and electrical world have helped to lengthen the business day in many ways. Arthur Brisbane, the famous newspaper man, has devised a cushioned box for use with an Edison dictating machine installed in his Owen magnetic car and he is shown in the accompanying illustration seated in his automobile with Thomas A. Edison, the inventor of the phonographic dictating machine. Mr. Brisbane travels back and forth daily from his home in Hempstead, L.I., to his office in New York in this car and with the dictating machine is enabled to add two hours to his working day—two working hours in the fresh air, as he expressed it. Mr. Brisbane suggests that a dictating machine installed in an automobile as shown should be of especial interest to business men who travel in their cars to and from their offices. "To work in a car with the window open," he declares, "fresh air pouring in, no interruptions from telephones, or callers, is indeed a luxury, and productive luxury, which is the only good luxury." Mr. Edison is shown talking into the dictating machine.



Thomas A. Edison Talking Into Dictation Phonograph Specially Mounted for Use While Travelling in Mr. Arthur Brisbane's Magnetic Drive Car. Mr. Brisbane at Right of Photo.

REPORT OF THE INVENTORS' LEAGUE OF THE U. S.

The Inventors' League of the United States held an important meeting on May twenty-ninth. A letter of Mr. M. A. Morrison, chairman of the Committee on Patents, House of Representatives, was read, in which he stated that the League's protests against certain bills now before the committee will be noted when such bills come up for hearing.

Mr. Benjamins suggested that patents should be exempt from seizure in connection with satisfactory judgments. He contended that a patent is of no value until it has been exploited, and such exemption would prevent the sale of a valuable patent, which the inventor has not been able to exploit and which are liable to be sold for a very nominal sum, thereby depriving the patentee of his hopes of future financial success.

Mr. Bahls suggested that members who cannot bring models of their inventions should exhibit drawings of such, so that interested parties could see them.

Mr. Munns advocated that the United States Government should issue a "guarantee" with patents granted, as the present issuance of a patent is nothing more or less than a license for the inventor to defend or fight for his rights. An additional charge for a "guaranteed" patent, either in a lump sum or an annual tax could be provided. This would act as an insurance against infringers and imitators, and would represent an "ownership of value." Such a law would put the burden of proof on the alleged infringer or imitator and would give a chance to the inventor of little or no financial backing to secure his rights without large expenses, which under the present law he cannot enjoy. This law also would provide for Constitutional meaning of "equal rights to all and special priveleges to none."

After further discussion in this matter by Messrs. Whigelt, Bang, Fowler, Bahls and Benjamins, a motion being made by Mr. Munns, the president was empowered to name a committee who should draw up the form of such a law and to have a report thereon made at the next meeting.

Address all communications on the matter to Ralph J. Lackner, recording secretary of the Inventors' League, 124 Maiden Lane, New York City, N.Y.

The Electric Optigraph—A Short Cut to Music

By B. F. Meissner

EDUCATORS of today are familiar with the wonderful results attained in recent years with the sentence-word-phonetic method of teaching language reading, as compared with the now almost obsolete a, b, c, and a, b—ab, e, b—eb methods prevalent twenty years ago. In those days children read one book per year, laboriously, mechanically, and without interest. Now they read from six to a dozen primers during the first year, and many classes read more! How is this possible?

The old method taught the alphabet, then nonsense syllables, then dull, uninteresting, unrelated sentences of the "See the ox go up!" "Can the cat run?" type. The new method provides stories from the very first page, usually folk tales and legends, which are of absorbing interest to the children. This modern method of teaching leads the children to recognize words, phrases, and even complete short sentences, at sight, by *visualizing* phrases, words and phonograms as quickly as letters, while nonsense syllables were formerly visualized.

As demonstrated in Dr. Huey's "Psychology and Pedagogy of Reading," reading by sentences, phrases and words saves eye-strain and mental fatigue. This is one of the most important phases of the new method.

That the psychological and physiological principles underlying the modern reading methods can be applied to the reading of music was first pointed out and applied by W. O. Meissner, director of the School of Music in the Milwaukee State Normal School. His experiments with school children extend over a period of fifteen years.

How many musicians—artists, if you will—live to-day who can read music as they read language?

After analyzing thousands of folk-songs, noting the characteristic *note phrases* and *motif groups** of which they were composed, and after eight years of experimenting with school children, testing their powers of visualization, memory, and so forth, Prof. Meissner developed what are known as the *music motif cards*, which serve the same purpose as sight-word or phonetic cards in the teaching of language reading.

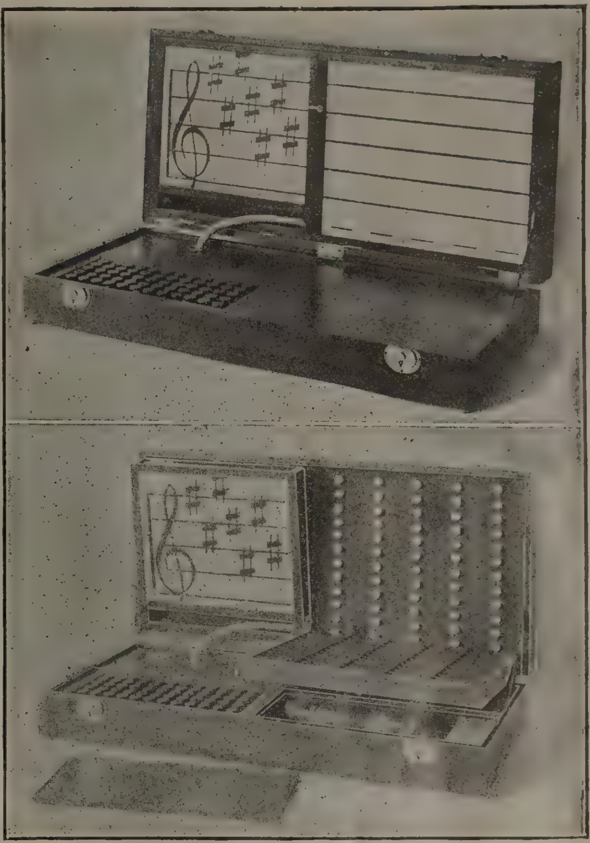
It has been the writer's great pleasure to suggest and perfect, with Prof. Meissner's assistance, what he and other authorities believe to be a complete solution of the difficulties encountered in the practical use of the manually manipulated motif cards for teaching motif-wise reading of music.

This solution embodies a means of instantaneously flashing the note groups on a transparent screen by means of manually operated push buttons and miniature electric lights.

The range of the instrument is an octave and a half, from middle C to the G above, and motifs containing any number of notes up to five may be flashed by pressing the lettered push buttons corresponding to the notes desired. These push buttons are of special design to produce the light touch necessary when several are operated simultaneously. They are contained within a space sufficiently small to facilitate easy operation, the experience gained by typewriter manufacturers being used as a guide in this particular matter.

The staff lines are printed on a dull, semi-transparent sheet of pyralin or celluloid, behind which are situated the miniature electric lamps of the "flashlight" type. The notes appear on the lines and spaces of this staff as solid ovals of soft red light, when the push buttons are depressed. The red notes, combined with the plainly visible lines of the staff, the dull, white celluloid background and the scientifically chosen proportion of these parts tend to minimize the purely physiological difficulties of rapid visualization.

This instrument, which has been named the Meissner Music Optigraph (from the Greek stem, op: light, and from the Latin grapho: to write) is self-contained in a suitable mahogany case, which measures about 20x12x5 inches and weighs about fifteen pounds. This case consists of two parts which are hinged together, much like a dress suit case. The upper part may be opened up to a vertical position and fixed there. This portion contains the staff, lights, etc., and is plainly visible throughout a large school room when placed upon the teacher's desk. The other portion contains the push buttons, batteries, pitch pipe, etc.



Instead of Using a Series of Motif Cards in Teaching Music There Is Now Available an Electric Optigraph in Which the Notes of the Motif Are Flashed by Lamps Behind a Transparent "Staff" and a Special Keyboard Controls the Lamps.

Another type of this instrument consists of the two separate parts as before, but not hinged together. One part, containing the staff and its lights, is hung upon the blackboard; the other, containing the push buttons, is connected to the former by a flexible cable and is operated in the lap of the teacher, who may watch both the motifs as she flashes them, and the children.

Battery renewals are necessary once or twice a year. Batteries of the ordinary flashlight type, obtainable at any hardware store, are used. They require the making of no connections, merely being slipped into place in a special compartment in the case.

The complete set of 124 original, manually manipulated Motif Cards permitted the use of 506 different motifs. The motif-making possibilities of the Music Optigraph are almost infinite. As calculated by the mathematical laws of Permutations and Combinations, the actual number of separate and distinct motifs obtainable exceeds 83,000,000. Of course the majority of these are nonsense combinations and the intelligent and skilful teacher would naturally demonstrate only those motifs which are in common use.

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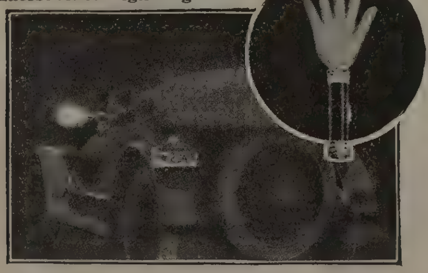
*Motif. In music, the original germ from which all musical form is evolved.

AN ILLUMINATED "HAND" FOR NIGHT DRIVING.

Safety in night driving is essential to real enjoyment and to promote this, some means of positive and sure night signaling seems to be necessary. There have been all sorts of mechanisms consisting of arrows, lights, swinging indicators and what not proposed and invented—but none have come into use to any great extent, because of being so different than the usual method of day signaling with the hand. Taking a left hand drive car the holding out of the left hand is universally and quickly recognized as a signal for a turn to the left, while holding the hand straight up is known to be the signal for a stop or turn to the right. A Milwaukee motorist noting how simple day signaling really was and how natural it is for one driver to watch the other, has invented an *illuminated hand* which he has called the *Universal Signal*. This device allows the motorist to signal at night in the same way as he does so naturally and unconsciously during the day-time. When he holds this signal out he feels sure the motorists following see his signal—he himself can see that it is working.

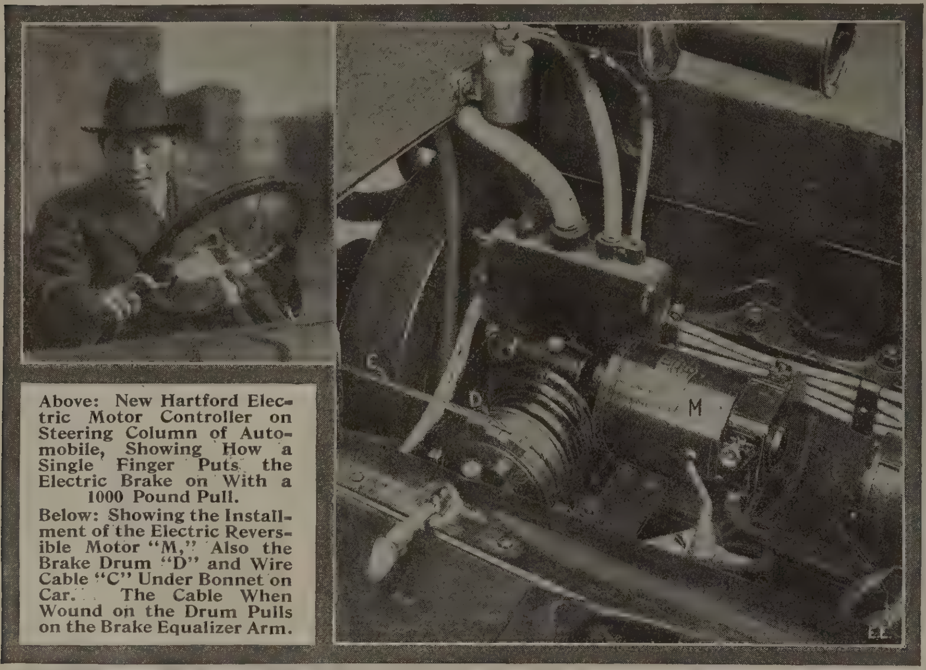
As can be seen in the accompanying illustrations the device is made up of a blown celluloid hand which is fitted over a tubular battery lamp. This lamp, which is lighted only for an instant when signaling, has a special reflector which throws the rays of the lamp uniformly into the hand and illuminates it so that it can easily be seen for at least 300 feet. The hand may be removed and the device used as an emergency lamp on the road or in the garage, which makes it desirable to have in any motor car. One of the city officials has also proposed the use of the device by the traffic officers not only for downtown intersections but for those stations in parks during concerts or other celebrations when it becomes necessary to have an officer in charge of traffic.

A Transparent Hand Lighted With a Battery Lamp, the Latest Auto Night Signal.



An Efficient Electrical Automobile Brake

FOR more than forty years engineers have been endeavoring to develop a more satisfactory and dependable braking system particularly for use on railway trains. The air brake is dependable, but not entirely satisfactory from a good many points of view and especially on account of its excessive weight.



Above: New Hartford Electric Motor Controller on Steering Column of Automobile, Showing How a Single Finger Puts the Electric Brake on With a 1000 Pound Pull.
Below: Showing the Installment of the Electric Reversible Motor "M," Also the Brake Drum "D" and Wire Cable "C" Under Bonnet on Car. The Cable When Wound on the Drum Pulls on the Brake Equalizer Arm.

Braking systems on automobiles to-day are as antiquated as the brakes on a railway train prior to the installation of the air brake.

Edward V. Hartford's latest invention, an electric brake, is of even greater importance than the air brake because it will do more, has a wider range of adaptability and, most important of all, the entire mechanism weighs only a fraction of the most approved air apparatus.

Try to imagine for an instant the likelihood of the modern railway vehicle using the old-fashioned hand operated brake. If the foot or hand operated brake is antiquated on the railway vehicle, why should it not be just as much out of date on the most marvelous specimen of engineering science—the modern automobile?

Every motorist knows how inefficient his brakes become when once the brake lining is worn through. It becomes almost impossible to slow down without locking the wheels. This sudden locking of the wheels could be overcome by the presence of oil between the brake drum and band, and allow gradual slowing down, but the presence of the oil would make it almost impossible to bring the vehicle to a dead stop owing to the fact that sufficient pressure could not be applied by either foot or hand levers.

The new electric brake completely reverses this order of things; the brakes are oiled with the result that a film of oil between the parts coming in contact must necessarily be squeezed out by the pressure of the brake so that the car is gradually slowed down automatically and as the pressure overcomes the resistance of the oil, the brake becomes proportionately more effective. It is possible with this improved form of brake to drive an automobile at a speed of fifty miles per hour up to within about thirty-five feet of a right angle turn and easily make the turn at fifteen miles an hour!

The complete system is compact and light, weighing only about thirty-five pounds, consisting of a small type reversible electric motor with a worm and worm wheel attached to a drum; to this drum is attached a steel cable, the other end of which is fastened to the brake equalizer arm.

The most important and novel part of the device is the controller, which is entirely new, so far as the control of electric motive power is concerned. It is extremely small and compact and placed within easy reach of the driver's hand as shown in the illustration.

With this type of switch a two-point control is given. The first point supplies enough braking power for service purposes and the second for an emergency stop. Pushing the switch back to its original position immediately disengages the brake. This motor is high-speed, series wound. The current can be applied by either a six, twelve or twenty-four volt storage battery for automobile or kindred usages, but heavier voltage can be used with equal success, the motor being wound for these voltages.

This motor has on the end of its armature shaft a worm which, through a reduction of 100 to 1 drives a gear. This gear in turn operates a drum by an internal gear through a reduction of 4 to 1. This gives a total reduction of 400 to 1. On the drum is wound a steel brake-pulling cable which directly transmits the pull of the motor to the braking mechanism.

When running idle the motor is capable of 10,000 revolutions per minute and when under load it can apply 1,000 pounds pull at about the same speed as would be the case with a quick application of the hand emergency brake. After 1,000 pounds' pull is exerted on the cable a "slipping clutch" prevents any further pull and a ratchet prevents the brake proper from slipping off. Because of the powerful pull on the brake cable the brakes run in oil. The current draw in putting a 1,000 pound pull on the cable is 40 amperes for two-fifths second. This brake replaces the emergency set and is used constantly in service, thus leaving the foot brake as originally installed for operation if wanted.

The death roll in motor car accidents is increasing at a terrible rate and any preventive such as a brake that will act almost instantaneously without requiring the driver to remove his hands from the steering wheel is most welcome.

One cardinal feature of this electric brake is that it can very easily be attached to any car now in use, provided it is equipped with storage batteries for ignition or lighting, or both.

INVISIBLE PERISCOPE WANTED, SAYS EDISON.

Thomas A. Edison recently suggested an idea for ambitious inventors.

"I wish some young fellow," he said, "would invent an invisible periscope. Let him get up a contrivance that will make it possible for a submarine to see its victim without projecting its huge, ugly eye out of the water to give warning. Then let him approach the Naval Consulting Board with this, and, if it is successful, his fame is made.

"And it shouldn't be so hard to invent," the world's greatest inventor added, "if some young fellow that's got brains gets to work at it."

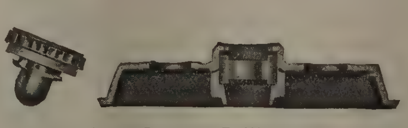
Mr. Edison is insistent that Congress build the government laboratory he has recommended, in which a thorough trial can be given to every idea for improving means of defence forwarded by poor inventors. There is only one way to invent, Edison says, and that is to invent; the government must realize this.

U. S. AND SPAIN TO TEST RADIO.

The big navy wireless station at Arlington is being tuned up for new transatlantic tests with stations in Spain soon. The tests will be at the request of the Spanish government. An improved wireless receiver, the invention of a Spanish scientist, will be tried at several stations in Spain. Both day and night tests will be made, American officials hoping they will result in more extensive use of wireless in the daytime, now seldom practicable over extremely long distances.

NEW AIR-TIGHT STORAGE BATTERY COVER AND PLUG.

One of the latest developments in storage battery details is a perfected cell cover with air-tight plug. This allows the battery to be kept dry and overcomes the unnecessary slopping and splashing of electrolyte, thus eliminating short-circuiting, rotting of trays and corrosion of metal parts. This ingenious filling plug can be loosened and removed or replaced and tightened by only a quarter turn. The illustrations herewith show a cross-sectional view of the cell cover with plug removed and also with the plug in place.



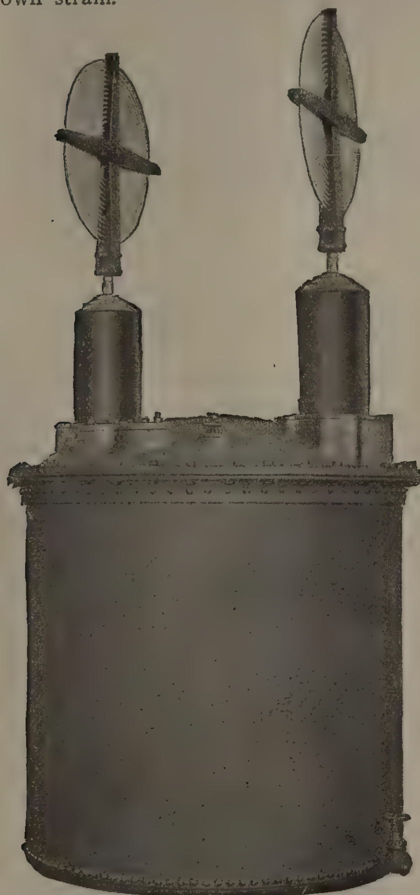
The Electrolyte Cannot Spill Out Thru This Storage Battery Cover.

This unique vent for storage cells absolutely prevents dust or other impurities from entering the cell and also limits the amount of water that can be put into the container to the exact amount required to replace that lost by evaporation.

The Cover Closed. It Limits the Water Added to the Exact Amount Necessary.

NEW 300,000 VOLT TESTING TRANSFORMER.

One of the largest high tension transformers ever constructed for testing work is illustrated herewith. It is one of the well-known General Electric line of transformers designed for high tension laboratory requirements and is oil insulated. The windings are of the latest type and particularly well impregnated so as to stand the extremely high potential here used—300,000 volts. The secondary terminals are provided with reactance coils in the form of spirals, as perceived, to choke back any surges which may take place in the high tension testing circuit and thus injure or break down the secondary windings of the transformer. The middle of the secondary winding is grounded to reduce the breakdown strain.



Monster 300,000 Volt Testing Transformer with Choke Coils.

The primary winding is wound for any commercial frequency and voltage. These transformers mark an epoch in American transformer design and manufacture.

ELECTRIC RANGE IN FORMER ROYAL RESIDENCE.

A former royal residence at Brighton, England, used by King George IV when he was Prince of Wales in the Eighteenth Century is now used as a public building, including the state apartments of the mayor.

In the kitchen the central feature is a huge old-fashioned roasting oven, but it is little used, as it has been flanked by electric ranges.

The electric range is everywhere supplanting the coal and gas stove for cooking.

NEW MOTOR DRIVEN DRILL.

One of the latest and most powerful electric drills on the market is depicted in the illustration herewith. These drills are built of sufficient size to accommodate ½-inch machine twist drills, so that they may be employed for boring holes through steel or iron plates, etc. They are particularly sturdy in design and the electrical features are well taken care of. The motor is air cooled to prevent undue heating and all the gears are run in grease, as also the spindle bearings. The whole drill may be taken apart in three minutes' time and the parts are so standardized that they are interchangeable.

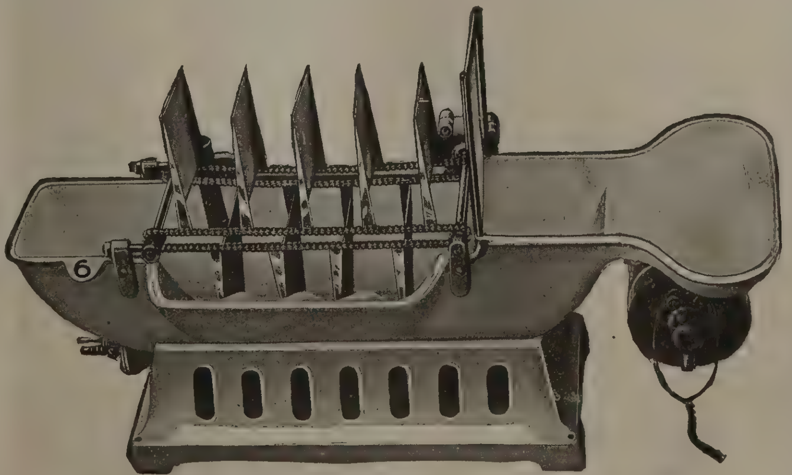
Powerful Motor Driven Drill.

They are supplied for service on 110 volts or 220 volts, and a convenient switch enables the motor to be started or stopped at will. The ½-inch drill weighs 18½ pounds and is designed for heavy service.

ELECTRIC EGG BOILER BRINGS THEM OUT AT THE RIGHT TIME.

The inventor of this device for automatically boiling eggs, claims that it is "fool-proof" and that it is superior to the old style clock machines in many ways. With this machine it is impossible to cook the egg more or less than the patron asks, that is, if it is placed in the right compartment. As observed in the illustration there are six compartments which are formed by paddles on an endless chain. When the eggs are placed in the compartment marked No. 1, which is nearest the drain board, they will be immersed in boiling water just one minute, if placed in the one marked No. 3, they will be cooked three minutes, and so on. When they have been in the machine the required number of minutes the paddles automatically deliver them to the drain board.

The machines are furnished with a 1/40 H.P. motor which may be connected to any lamp socket. The base and body of the machine are made of cast iron which is nickel-plated; the traveling chain, sprockets and trimmings are of brass. The base of the machine is 20 inches long by 9,5 inches wide, while the tank, including the drain board, is 32 inches long. The height of the machine over all is 11.5 inches. It weighs but 80 pounds. When desired it may be fitted to be run on gas or steam heat.

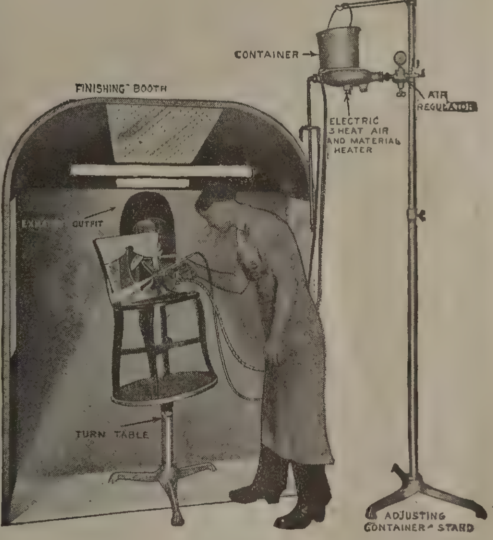


This Electric Egg Boiler Turns Them Out at the Desired Moment.

LET THE ELECTRIC AIR BRUSH DO YOUR PAINTING.

To those who are concerned with the problem of painting furniture or other articles of wood or metal in a smooth, even, first-class manner, the latest form of electrically actuated air brush adapted for this work and here illustrated will appeal. It is suitable for producing finishes of enamel, varnish, shellac, bronze, mica, celluloid or other liquid materials. The equipment in general consists of a finishing hood or booth, a motor driven exhaust outfit, a liquid container, an electric three-degree air and material heater, an air regulator and a turntable on which the article to be painted or varnished is placed.

The illustration here shown depicts a complete outfit for finishing chairs. A wired glass window is placed in the sides and top of the finishing booth, thus permitting ample light for all operations. An electrically driven exhaust fan is used in some of these outfits, especially for the closed type of booth. The motor driven blower supplies air pressure for operating the brush nozzle, from which the paint is sprayed in a fine stream on the furniture or other objects. The material and air heater is mounted next to the paint or varnish container and is designed with a special switch control. This arrangement will deliver sufficient heat so that the liquid can be applied at a temperature of 120 degrees Fahrenheit or at even greater temperatures if desired.


CONTAINER
FINISHING BOOTH
AIR REGULATOR
ELECTRIC 3 HEAT AIR AND MATERIAL HEATER
OUTFIT
TURN TABLE
ADJUSTING CONTAINER STAND

Electric Air Brush Outfit for Finishing Chairs.

The banks of searchlights used at the Panama Exposition for securing the "scintillator" effects have been purchased by the Russian Government. They are the most powerful ever designed and should prove extremely serviceable for military work.

An Early Power Battery

IN the early days of electric lighting, when most of the present readers of this journal were probably in the babyhood stage or else unsuspected as yet. many novel and ingenious devices for producing electric lights with all the attendant conveniences were promulgated and developed. A scheme which was thought to be quite practical in those epochal days was that employing a large battery comprising a great number of individual cells.

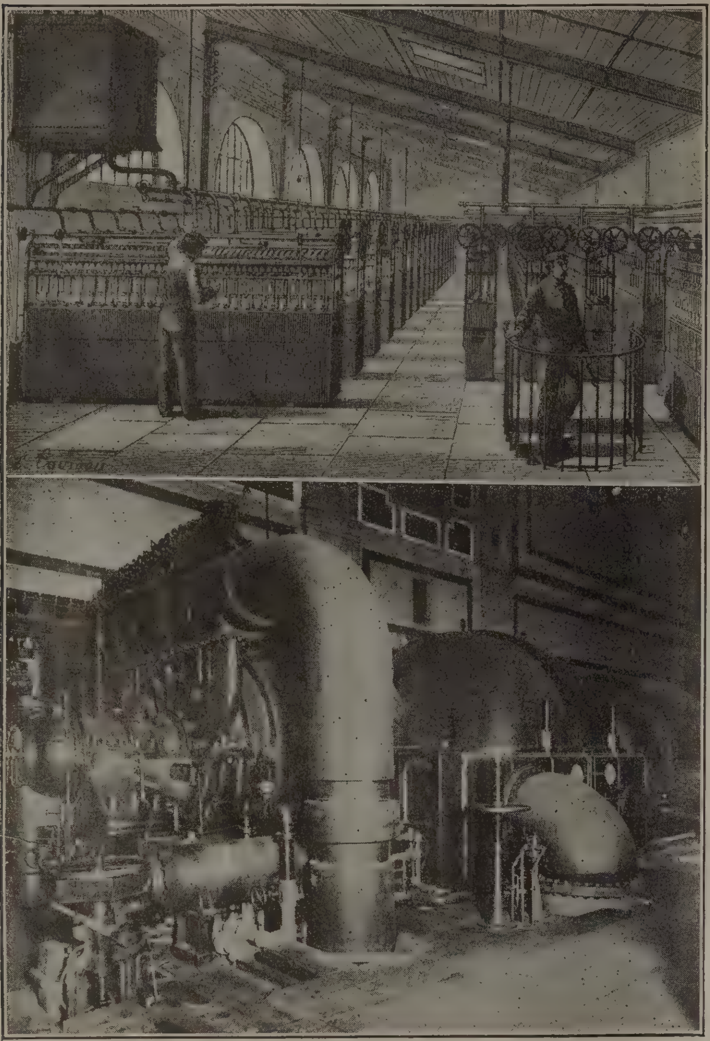


Fig. 1. First We See (Above) One of the Greatest Electric Novelties of a Half-Century Ago, a Huge Battery Which Lighted an Early French Bank. Compare it with The Modern Turbo-Alternator Below, Which, altho Much Smaller in Size, Can Deliver Many Hundred Times the Output of the Battery.

In the old illustration herewith reproduced can be seen such a large battery consisting of several hundred monstrous cells of the bichromate of potash type. An attendant is seen in the act of admitting fresh water to the battery solution, his hand resting on a pipe valve which controls the water supply from the tank observed in the upper right corner of the illustration. When not in use the zinc elements of the cells could be readily raised from the solution so as not to deteriorate, by means of two geared shafts running the full length of the battery compartment. The water supply pipes run to each battery as observed and thus the installation was readily taken care of and maintained with a minimum amount of labor.

Fig. 2 shows the details of the most ingenuous bichromate battery for power purposes, ever invented.

This battery was constructed in the 70's by Grenet Garriaut of Paris and it was used for lighting up electrically the immense banking establishment, the Comptoir d'escompte of Paris. Altogether there were sixty large battery-units, each comprising 48 cells. These units were divided into two rows as will be observed from Fig. 1. Each cell was made of hard rubber and contained four carbon plates joined together by means of a cast leaden head—L. Each cell contained an overflow tube, i, allowing surplus liquid to drain off. On the leaden head, L, there were, furthermore, two small tubes, P, going down to the bottom; through these compressed air was blown to help in depolarizing the batteries. The positive electrode was constructed of six zinc rods, O, having a diameter of one centimeter each. These rods were held in position by rubber bands and were further connected to the copper rod S, which carried at its top a hard rubber receptacle containing mercury. The latter took care of the amalgamation of the zincs.

From the wooden cross pieces, V, carrying the zinc poles, copper rods dipped into tubes, P, containing mercury; these established contact with the carbon plates of the next cell, connecting the cells in series thereby. By means of this ingenuous arrangement all zincs could be lifted from all the cells, simultaneously, without touching a single screw.

Finally a tube, E, carrying the battery solution, dipped into each cell. This solution was made by mixing 76 lbs. of bichromate of sodium with 150 lbs. of concentrated sulphuric acid together with 2,000 lbs. of water. This electrolyte was then pumped to the roof into large vats and from there it was distributed into the automatic pans, D, made of hard rubber. From here the liquid dropped into similar pans, E. If now stopcock C released say one quart of electrolyte, D would tip over and pour its contents into E, from where it would run into its cell. The stopcock C was so regulated that twenty quarts of new liquid were supplied to the battery for every hour during operation. The weak liquid in turn would flow off through i.

Running parallel with the battery was a water supply pipe, used to flush out the cells after use.

A third string of pipes, two of which terminated into the little pipes O, supplied the compressed air to stir up the solution and to add a fresh supply of oxygen to it.

In Fig. 1 will be seen a side view of one of the batteries carrying the large geared wheels at the top. These were used to lift all the zincs from the cells simultaneously.

While this most ingenuous battery, costing over $25,000, was in use for several years, and while it performed its duties surprisingly well the cost of maintaining it, as well as the current cost was not exactly in keeping with the figures supplied by its builders. So when the dynamo made its triumphant appearance, this masterpiece of ingenuity was relegated to the scrap heap.

Needless to say the electric light in the early days of the art was more of a luxury than anything else and a rather expensive commodity to say the least. Such plants as this were installed in a number of French public buildings and private houses, but it was not many years before the first lighting dynamos were developed. These soon superseded the batteries, which were quite inefficient and troublesome in more ways than one.

Compared to the early form of electric power plant above described, employing a large number of batteries, it is interesting to contrast the comparative size, remarkable efficiency and output of a modern "turbo-alternator," such as that shown in the illustration Fig. 1. This monster machine, which would only require about ¼ of the space of that utilized for the installation of the battery cells in the old plant here cited, can develop 30,000 K. W.

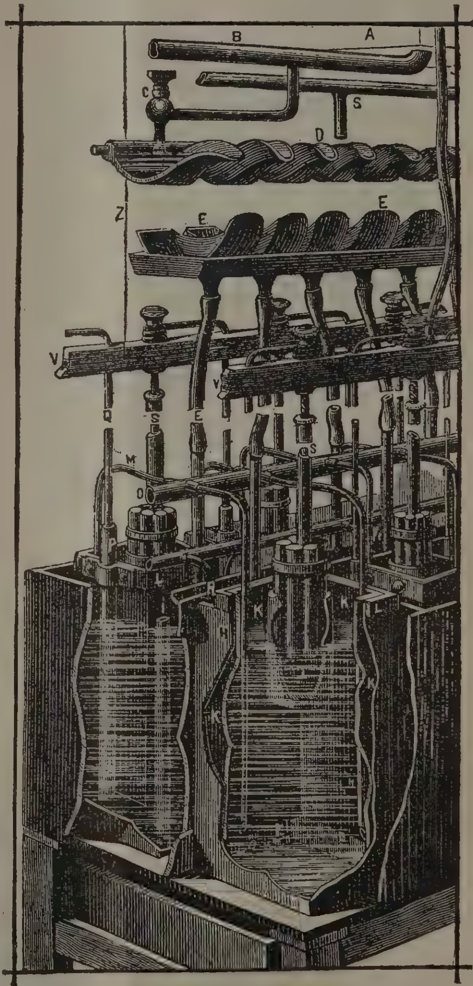
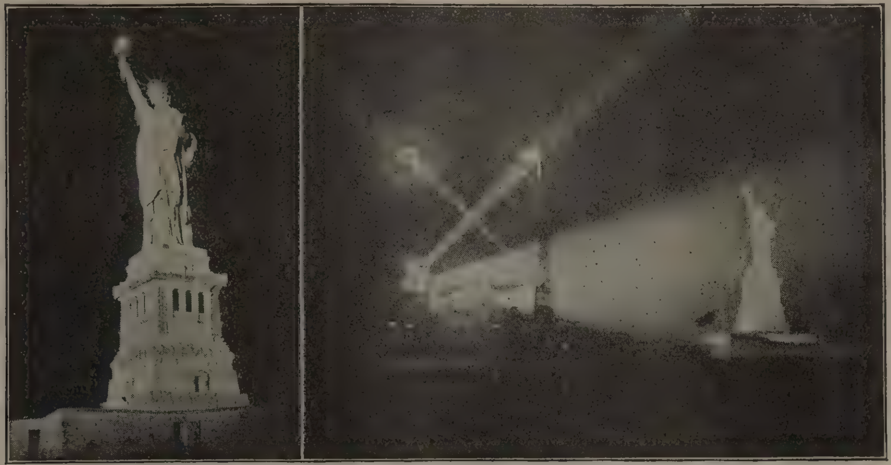


Fig. 2. Detailed View of Early Power Battery. It Was of the Primary Type and Was Charged with Chemicals.

(*Continued on page 286*)

Statue of Liberty to be Flood-Lighted.

"Liberty Enlightening the World" was truly a goddess of light on the night of May thirty-first when for fifty minutes the noble bronze figure in New York Harbor stood bathed in the rays of six powerful searchlights of the United States battleship *Michigan*, lying a few hundred yards east of Bedloe's Island.



Statue of Liberty in New York Harbor Illuminated at Night by Powerful Searchlights of U. S. Battleship *Michigan*. A Fund Is Being Raised to Flood-light It Like This Perpetually.

Spectators of this scene prophesy Liberty's permanent illumination, for which a fund of $30,000 is being collected by the New York *World* and members of the General Federation of Women's Clubs and their friends on board the *Grand Republic*, the largest excursion boat in New York Harbor.

Following the spectacle of Liberty's full figure cast in light against the blackness of the night, a meeting in the cabin of the *Grand Republic* brought out strong commendation of the illumination project by the club women and by New York officials.

Measures agreed upon by women of many states before the boat reached its landing insure the efforts of thousands of women throughout the country toward rapidly completing the fund for the lighting plant which is to be presented to the Government.

The illumination was ordered by the Secretary of the Navy to afford an approximation of the effect that will be produced by the permanent lighting of the statue proposed by the New York *World*.

Congress has passed an amendment to the Rivers and Harbors Bill authorizing acceptance by the Federal Government of a fund of $30,000 to purchase an illuminating plant, which the Government will maintain. Many small contributions to this fund are sought in order that the lighting of the famous statue shall be in keeping with the traditions of this gift of the people of France to the people of the United States.

The illumination of the Statue of Liberty made a spectacle for tens of thousands of persons in Battery Park, along the Jersey shore to the Atlantic Highlands and at vantage points in Manhattan and Brooklyn.

At eight twenty-five p.m., the *Michigan*, which, since morning, under orders from Secretary Daniels to Captain C. C. Brittain, had lain off Bedloe's Island, shot her powerful searchlights across the harbor. Two of them, diagonally from each turret, illuminated large American flags at the mast heads. The six others, sweeping widely at first, slowly centered on the figure of Liberty, shooting first a ray of intense white light across the yellow gleam of her upheld torch, making it for the first time in the evening truly distinguishable from the other harbor lights.

Then, bringing into its focus the rest of the form and finally the pedestal, the light transformed the dark bulk of the statue into a softly shimmering, distinct and startling figure, a lighted and significant center to the harbor. The time-greened bronze of Bartholdi's giant goddess so received the light that, as the eyes watched closely, the statue grew less vivid in its luminousness, but none the less distinct. To any one not knowing of its presence in the darkness, its sudden vitalizing must have seemed nothing less than mystic.

But, imposing as was this spectacle of the giantess and her pedestal fully revealed in the sun-bright glare of the searchlights, it is believed that when the statue is silhouetted by her own thousands of electric lights, with beams so shaded that all rays will be thrown directly upward, the spectacle will be even more imposing.

Our front cover, painted by our capable artist, Mr. George Wall, gives a good idea how old Liberty will appear when the electric lighting scheme is completed.

The *World's* plan to illuminate the statue provides for a lighting system costing $30,000, to be paid for by popular subscription and to be maintained by the Government.

The indirect light, such as is employed on the great towers of the city, will make Liberty Enlightening the World the most impressive landmark of New York.

All contributions should be sent to Statue of Liberty Illumination Fund, The *World*, New York. All contributions, both large and small, are welcome.

ALLIES FIND RADIO USEFUL ON BATTLEFIELD.

Radio telegraphy has played a very important rôle in the present European conflict, and the photo herewith presented clearly illustrates several members of the Allies' aviation squad, using a military field radio outfit in the vicinity of Salonika. The Entente Powers have spent a considerable amount of money and time in perfecting their apparatus, for both efficiency and rugged use.

The apparatus shown in this photograph is very heavily built. The transmitting side consists of a small transformer of high efficiency enclosed in the round cornered box. The spark gap is placed on the top of the case. At the front is a handle which controls a rheostat for regulating the amount of power transmitted to the coil. The condenser is inside the box. The key is heavily built, and is fitted with insulating disks to protect the contact points, as can be seen in the illustration. The power is obtained from a dynamo driven by a gasoline engine.

The receiving set at the left is of the loosely coupled type, the coils of which are enclosed in a substantially built case. The primary and secondary inductances are controlled by the insulating handles projecting through the cover. Two variable condensers are used, one in the primary circuit and the other is shunted across the secondary. The detector employed in this set is mounted on a stand, which is secured on the cover. This detector is very sensitive, yet difficult to put out of adjustment once it is set for its most sensitive point. Two pairs of high resistance 'phones are usually employed with these sets.

A portable mast supports the antenna; a pipe, driven in the ground, makes connection with the earth.

A very interesting feature in the operation of this radio set is that one operator receives while the other transmits.

These portable sets are used in connection with the aeroplanes for directing the range-finders who handle the big guns.

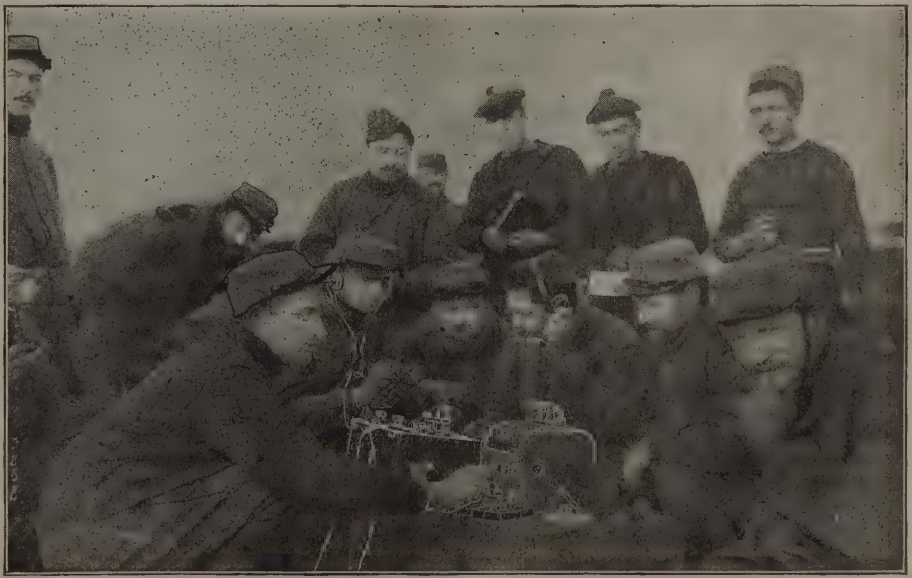


Photo Copyright by International Film Service.

A French Aviation Radio Squad in the Vicinity of Salonika.

A SUCCESSFUL LOUD-TALKING TELEPHONE.

The loud-talking telephone has undoubtedly played an important part in many modern business establishments, although it is quite new. Herewith we present illustrations of two of the latest loud-speakers, which are entirely different from those now in use. The unique feature of this type of telephone is that it employs a transmitter and receiver placed in a single horn which represents a radical departure from the present designs in vogue which employ separate instruments placed in two different horns.

The instrument depicted at the right is largely used in department stores, etc. The receiver is located on the upper part of the horn, as depicted in the illustration, while the transmitter is placed just behind the opening of the horn which, of course, can not be seen.

The design shown on the left of the illustration represents apparently a standard form of table lamp, but it contains besides a microphone and receiver. The receiver is of oblong form and may be observed between the base and shade of the lamp. The transmitter is located in the upper, inner corner of the shade. This lamp can thus be placed anywhere to serve two purposes, that of a lamp and also a loudspeaker. One of the unique features of this latest form of loud-talking device is that the microphone is not affected by the loud noises produced by the receiver when it is in operation. This is accomplished by employing a clever automatic switch, which cuts the transmitter out of the circuit when the telephone is being used for receiving. In large installations a switchboard is employed which is used to connect the various telephones in the building.

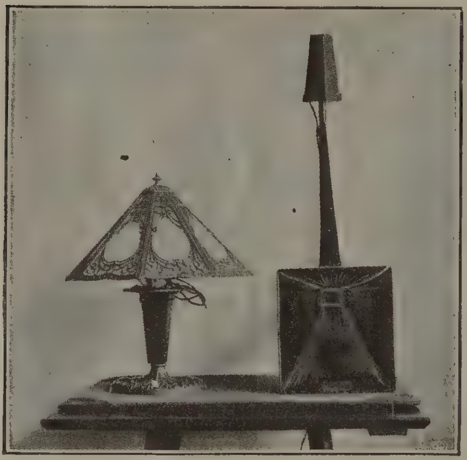


Photo by courtesy of the International Callophone Corporation.

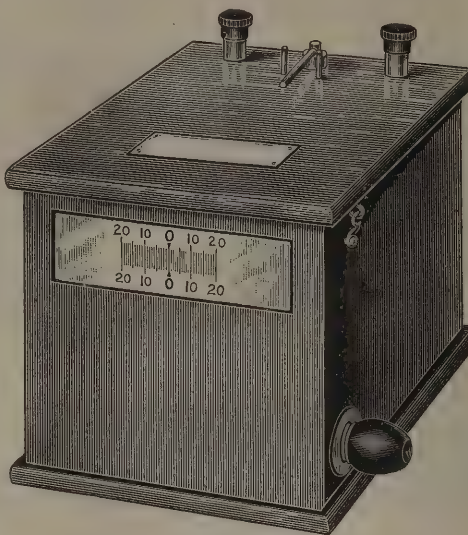
The Lamp at the Left Contains a Microphone and Loud-Talker; Improved Loud Talker with Horn at Right.

It is well known that the present type of loud talkers use a considerable amount of current, ranging from 4 to 6 amperes. The receivers are, therefore, wound to a low resistance. In the type of 'phones herewith described the principle of using a large amount of current is eliminated and the coils of the receiver are wound for a fairly high resistance.

The reduction of the amount of current used and at the same time maintaining the same intensity of sound produced by the receiver is due to the employment of the D'Arsonval principle, where two coils are so placed in the magnetic field (which consists of several permanent magnets), that they will act upon an iron armature which transmits the motion so produced in it to a mica diafram. Thus it will be seen that this form of receiver is far more sensitive than the old type, as this employs a push and a pull action on the diafram while the others are operated by a pull caused by the attraction of the electro magnets. The loud-speaking telephone is rapidly coming to the front, and deserves a wide application.

A COMPACT LAMP AND SCALE GALVANOMETER.

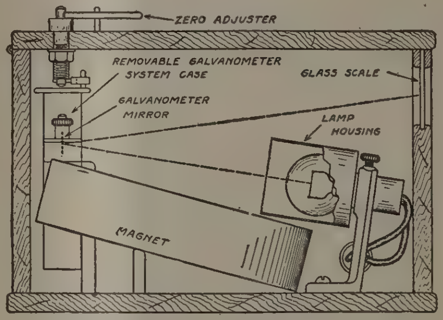
The illustration herewith, together with the sectional diagram, shows one of the latest innovations in the realm of galvanometers for laboratory and other requirements. This ingenious instrument is entirely self-contained and embodies the source of light, galvanometer movement and scale all in one cabinet, measuring but 8½x5½x5½ inches. The outfit complete weighs about 5½ pounds.



Portable Lamp and Scale Galvanometer.

As perceived from the diagrammatic view, there is a powerful permanent steel magnet mounted in the base of the cabinet and the moving element is contained in a very sturdy interchangeable and readily removable casing. This enables the delicate part of the apparatus to be removed at any time for replacement or repairs. The small rod observed on top of the cabinet between the two binding posts is for the purpose of setting the galvanometer to zero. A convenient connector for attaching the lamp to a 4 volt battery circuit is also provided. The scale is finished in black on a translucent background and is usually furnished with the zero in the center, but when desired the zero graduation may be placed at one end of the scale. The incandescent lamp employed with this instrument is of the single, straight filament type, of high intrinsic brilliancy. It requires .5 ampere on 4 volt current for its operation but when desired may be operated from a 110 volt circuit with a suitable resistance or 110 volt lamp in series.

The galvanometer system is equipped with a concave mirror of minute size so that by a small movement of the lamp the image of the lamp filament may be focused on the translucent scale. When this has once been focused properly it requires no further attention during the life of the lamp. The galvanometer coil is suspended and not supported with pivots and jewels. This eliminates sluggishness due to dirty jewels or pivots and also any trouble accruing from cracked jewels or dulled pivot points. This instrument will undoubtedly find a wide field of usefulness, particularly in view of its substantial construction and the absence of delicate parts which usually accompany such apparatus.



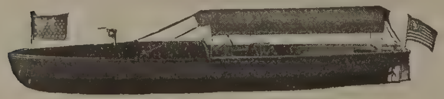
Interior View of Compact Mirror Galvanometer.

CHINESE LIKE ELECTRIC TOASTERS.

In Shanghai, China, about 10,000 houses were reported under construction during the current year. Of this number, 1,500 were fitted with electric service. Besides electric lights, the electrical appliances, particularly toasters, are heavily in demand among leading Chinese families. Extensions to the Shanghai electric plant resulted in increasing the importation of electrical machinery over $300,000.

NOVEL ELECTRIC BOAT MODELS.

An enterprising American toy manufacturer has developed several unique electric boat models, among which are those illustrated here, including a replica of an up-to-date motor speed boat, trawler or lake freighter and a battleship. These are fitted with a properly proportioned electric motor which drives the propeller at high speed. Dry batteries form the source of current supply for the motor and by setting the rudder of these models at a certain angle, the boat may be made to maneuver in any desired direction. The trawler is of the type of those used on the Great Lakes and the battleship is of the United States Navy type. These model vessels are very complete in their make-up and would thoroughly please any boy.



Motor Boat Model.

Electric Battleship Model.

Trawler or Lake Freighter.

NEW DYNAMOMETER FOR TESTING SMALL MACHINES.

In the accompanying illustration is shown a small electric dynamometer, which is especially adapted for testing motorcycle engines, small pumps, blowers and various types of small machinery on which the manufacturer wishes to keep accurate test records. The dynamometer consists of a generator with a steel frame and operates at speeds up to and including 5,000 r.p.m. Speed adjustments are obtained by field control. The frame of the dynamometer is equipped with arms with distance carefully laid out from the center line of the shaft. With the device shown it is necessary only to read the speed in r.p.m. from a tachometer, and the weight in pounds from a standard scale in order to determine the horse-power developed by the engine at the time of reading. No electrical readings are necessary, and the efficiency of the dynamometer does not enter into the calculations. The dynamometer is being made by a large eastern electrical manufacturing concern and should find a wide field of application.

Simple Form of Dynamometer for Measuring Horse-power of Small Engines and Other Machinery.

WHEN YOUR AUTO MAGNETO BECOMES WEAK.

Magnetos of standard make, as generally used in automobiles, have much in their favor and when in good condition furnish an excellent source of current for ignition. They are simple, produce a hot spark and the problem of insulation is not usually very complex. Like all rapidly revolving mechanism, however, they are subject to considerable deterioration. Probably most of the trouble encountered and the hardest to find is diminished power, due to weak magnets.

The engine does not skip. In fact each explosion takes place with due regularity, and to all appearances there is a good spark when the spark plugs are tested outside of the cylinder, but the operator feels that his car has lost the snappiness and zip of former days. He wonders why he has to change from high to low speed more frequently than he used to.

Even before the trouble has reached an acute stage there is a general sluggishness in the action of the car which materially lessens the pleasure of driving; and, strange as it may seem, the motorist seldom attributes the trouble to magneto deterioration.

Garage and service station men have long been in need of a means of charging such weak magnets without the necessity of sending them out to be remagnetized, causing considerable delay and expense. The principal drawback has been the annoying absence of a 110-volt direct current line and the expense of a suitable charging coil.

The new magnet charger here illustrated operates from an ordinary 6-volt storage battery, five or six dry cells from a storage battery charging outfit, such as are used to charge starting or lighting batteries. One of these sources of current is to be found in almost every garage or repair shop.

This magnetizer consists of a charger, charging board, polarity indicator, switch, conducting cords and also attachments for magnetizing Ford magnetos without removing the magnets from the fly-wheel.

The operation of the device is very simple, as well as economical. There is no guess work and three or four applications of the current on each leg of the magnet is sufficient to bring any magnet up to the "full saturation point," it is claimed.

Clever Battery Magnetizer Recharging a Ford Magneto.

RADIO STATION FOR SOCIETY ISLANDS NEAR COMPLETION.

The radio station now being built by the French Government on Tahiti Island, Society Islands, will be ready to receive and transmit commercial messages shortly, the United States Bureau of Navigation announces. The temporary station now in course of erection will be followed by a much more powerful plant. The plans of the temporary station contemplate a 10-kilowatt installation of the type used by the French Government, with a wave length of 600 meters. The two towers will be 100 meters in height. The station will be expected to reach Awanui, New Zealand; Suva, Fiji, and the Samoan Islands.

Immediately upon the completion of the temporary station work will begin on the permanent station. This permanent 300-kilowatt station will be operated by a 500-horsepower gasoline engine, and will use a wave length of 2,500 meters. There will be eight towers, each 100 meters high, erected in parallel rows of four towers. The space between the towers will be 250 meters, and 200 meters between parallels. There will be two antennas, one of 600 meters wave length, the other of 2,500 meters.

UNIQUE PORTABLE ELECTRIC WELDER.

The accompanying illustration depicts a portable electric welding outfit used in welding metallic bands around packing cases, barrels, et cetera. This welder was primarily brought out to supply the demand from packers of various sorts of bottled goods to secure bands of strap metal or wires around packing cases and to "weld" the ends together, thereby forming a seal.

Portable Electric Welder Useful in Sealing Binding Wires on Cases, Barrels, Etc.

The step-down transformer is contained in a small aluminum case as shown and supplies the heavy welding current necessary, which is carried by means of two very flexible cables to the welding tongs, these being made up in the form of a pair of pliers. These tongs are equipped with renewable dies ½ inch in diameter and which may be made up by the user of ½-inch round bar copper from time to time as may be necessary. This is the only part of the welder subject to wear.

The current is turned on and off automatically, as each weld is made, by a switch located between the two handles of the tongs. Proper pressure is secured at the dies for forcing the partially molten metal together by means of a spring, which is adjustable. These tongs are made of phosphor bronze and of non-ferrous metals so as to make them adaptable for immersing in a pail of water for cooling.

The current required for the operation of this outfit is not in excess of ½ kw., and it can be attached to any lamp socket, as shown in the illustration, in the same manner that portable electric drills are connected. The weight of the entire outfit is about 25 pounds.

In further explanation of the method of operation, the stock is inserted between the two dies of the welder and pressure is applied by squeezing the handles together, which also causes the dies to close upon the work—further pressure of the hand compresses the spring for giving the dies the proper pressure and also operates the automatic switch for turning the current on and off. All of this is done by one operation of squeezing the hand as is done in cutting the wire with a pair of pliers. The time consumed for the whole cycle of operations is a small fraction of a second.

The use of this device has shown quite a saving over the method using lead seals.

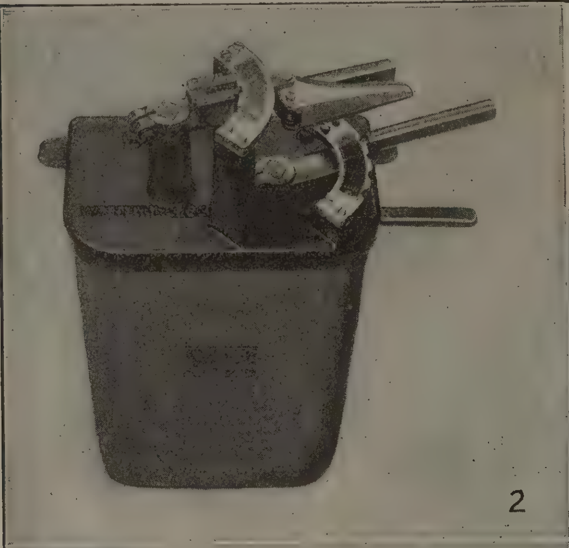
The Liquid Rheostat In Locomotive Service.

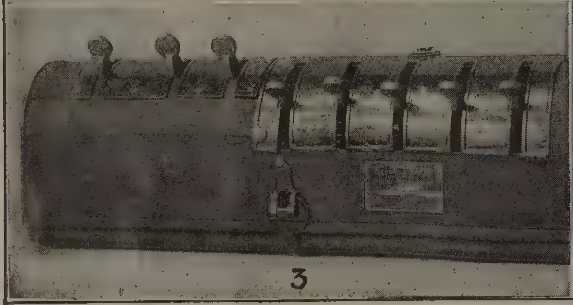
Liquid rheostats in locomotive service were successfully used for the first time in this country to control three phase induction motors on the Norfolk and Western locomotives, which have certain operating characteristics, resembling very closely those of the steam locomotive, especially the manipulation and the amount of abuse they will stand without being materially damaged.

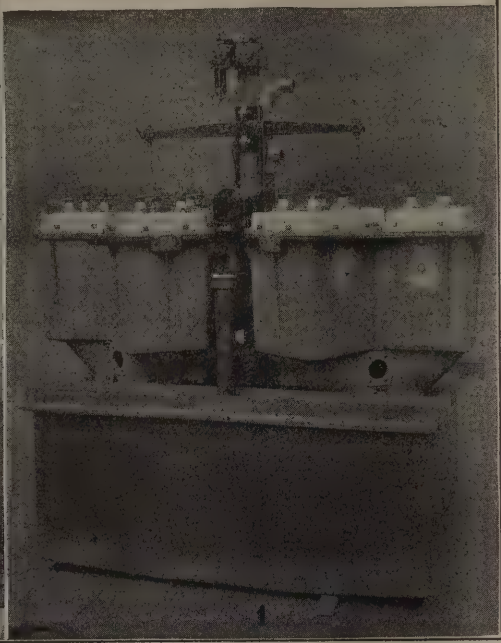
Fig. 1 (Below).—Appearance of Tanks of Liquid Rheostat Designed for Use in Locomotive Service.

Fig. 2.—The Master Controller for Liquid Rheostat Circuits, Containing Forward and Reverse Switch Drums and Interlocking Device.

Fig. 3.—View of Auxiliary Controller Used in Regulating Phase Converters and Distributing Load on Motors.







The principal functions required of these rheostats are: to cut out the resistance in the secondary circuit of the main motors while accelerating, or regenerating, to compensate for the slip between the different pairs of motors due to the variation in the size of drivers, and to make and break the circuit to reduce wear on the primary switches.

The liquid rheostat, shown in Fig. 1, consists of a main casting, divided into four compartments, a central one and three arranged in triangular form around it. A set of electrodes is mounted in each of the three compartments. In each compartment one electrode is grounded to the side of the main casting and the other is suspended from the top cover and insulated from the ground by three porcelain insulators, as in the photo. The rods which support the latter electrode are connected by copper straps on the outside of the cover. Each set of electrodes is connected through a pole change-over switch to the secondary of a three phase motor. The electrolyte furnishes resistance between the insulated electrodes suspended from the cover and those grounded on the side of the main casting, thus making the main casting the common point of the star connection. The electrodes are made up of iron plates. The effective area gradually increases and the resistance in the circuit decreases as the surface of the liquid rises.

Two of these rheostats are mounted on top of the main supply tank, containing the electrolyte, which consists of a 5 to 1 per cent. solution of anhydrous sodium carbonate.

The operating device in the center of the rheostat is controlled by a balanced pressure operating mechanism, which is mounted above and between the two rheostats. The cross arm extending from this mechanism is connected to each of the overflow tubes by a rod. Thus the raising or the lowering of this cross arm raises or lowers the level of the liquid, which in turn varies the surface of the electrodes submerged.

The master controller, Fig. 2, consists of two separate and independently operated drums, neither of which are mechanically interlocked with the other, but both are interlocked with the reverse drum, so that both handles must be in the "off" positions before the reverse drum can be thrown. The speed drum has four "on" positions to set up the required combination of pole changes over the drums, reverser and primary switches.

In addition to the master controller, an auxiliary controller, Fig. 3, is provided, in which are located levers for the control of the phase converters and a set of levers by means of which the load on each pair of motors may be governed independently. This independent control is provided so that any difference of load between the various trucks may be corrected, such as that due to difference in wheel diameter, variation in electrolyte, etc.

The results obtained in this severe service, in flexibility of control, capacity and ability to withstand extraordinary duty, have demonstrated conclusively the distinct advantage of this method of control.

LONG SPANS OF ALUMINUM WIRE.

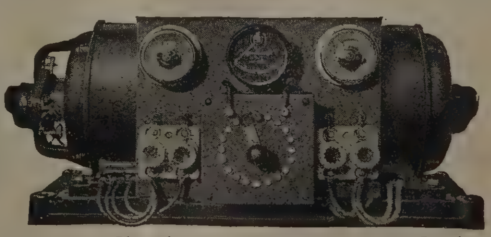
Due to its low tensile strength the economies resulting from the substitution of aluminum transmission cables instead of those of copper is offset by the increased number of supports which are necessary because there can be no long spans of aluminum wire. However, the difficulty of using aluminum cables economically has recently been apparently overcome by the combining of a steel core with an aluminum covering; the former furnishing the necessary tensile strength and the latter conducting the electric current. The steel core may be made either of a single wire or of several strands, while around it are wound the aluminum strands.

BATTERY CHARGING SET FOR AUTOS.

Every garage operator and automobile owner has experienced the need of a convenient means for charging small storage batteries, such as are used to-day on practically all up-to-date gasoline cars for starting, lighting and ignition service. Launch owners also have experienced the same need.

For economically charging these small storage batteries, there has been developed an equipment of the form shown in the illustration. This simple, compact motor-generator can be connected to a 110 or 220-volt, 60-cycle, alternating current or 115 or 230-volt direct current. The motor-generator takes its power from the line and generates direct current at a voltage slightly higher than that of the battery (or about 2.8 volts for each cell to be charged).

The panel and the charging set are supplied completely wired ready for operation, which is extremely simple. The motor is first connected to the supply circuit and then started by means of a snap switch. The battery is connected to the generator terminals and the charge rate adjusted by means of the field rheostat to the value shown on the battery name plate. The charging is continued according to the method recommended by the battery manufacturer. As the generator is shunt wound, its voltage increases as the ampere load decreases. That is as the battery approaches a charged condition the potential of the generator automatically rises to the higher value required for finishing the charge. This voltage characteristic is a great advantage where lead batteries are to be charged, because it permits the operator to give the battery an equalizing or long-period low-rate charge which prolongs the battery life.



Battery-Charging Motor-Generator with Steel Switch Panel.

The complete charging equipment includes a motor-generator and a charging panel with the necessary controlling rheostat, ammeter, switches and fuses mounted on a steel switch panel. Snap switches and fuses control both the motor and generator. The outfit is simple and compact; it is easily installed and operated.

HANS CHRISTIAN OERSTED.

August Marks His 139th Birth Anniversary.

Born Aug. 14, 1777—Died Oct. 9, 1851.

Hans Christian Oersted was born on August 14, 1777, at Rudkjoebing, on the Danish island of Langeland, where his father had a pharmacy.

Beginning in the year 1794, Oersted studied medicine at the University of Copenhagen, and in the year 1799 he was made Doctor of Philosophy. After he had traveled, in the years 1801 to 1803, through France, Germany and Holland, he took up chemical and physical studies in earnest and in the year 1806 he was made Professor of Physics.

In 1813 and 1814 he was again in Germany, and during his stay in Berlin he published an important work entitled "Views on Chemical and Natural Laws." This work, with the aid of Marcel De Serres, was re-written and published in French under the title of "Researches on the Identity of the Electric and Chemical Forces."

Later he went to England, where he stayed for a short time before his return to Copenhagen. In 1824 he founded a society for promoting the study of natural history. Five years after this he accepted the position of director of the Polytechnic Institute.

His most brilliant discovery, that of electro-magnetism, was made in the year 1819. It is said that he made this discovery purely by chance. Oersted had been working with a Galvanic pile, while at the same time there was a magnetic needle on the table, and as often as the current went through the wire, the needle was deflected from its original position. While this was perhaps pure chance, and while the experiment was not made purposely, Oersted received the greatest credit and merit, inasmuch as he himself had long thought, in connection with Whewell, that there must be a certain relation existing between electricity and magnetism. Oersted had worked long and industriously on the problem and perhaps more than any other man in Europe.

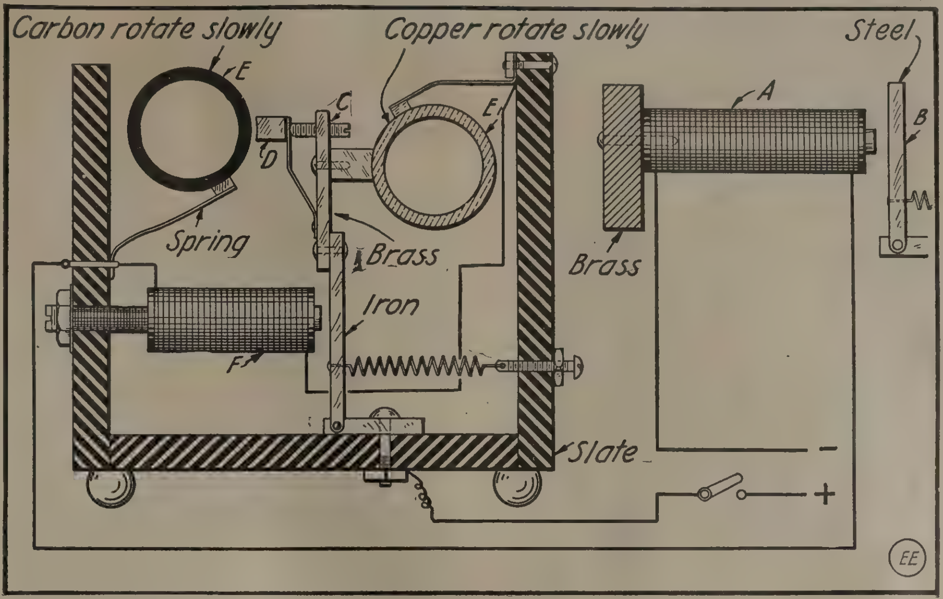
This is proved by the fact that in 1807 he had published a paper in which he said that for a long time he had believed that electricity in a certain form would exert an action on a magnet. Therefore, his discovery was the natural result of his work, and it is almost certain that had he not made the discovery by chance, he would no doubt have found the relation between electricity and magnetism sooner or later, by pure reasoning and theoretical deduction.

Hans Christian Oersted, Discoverer of Electro-Magnetism, the Basis of All Modern Electric Machinery.

From 1824 until his death, October 9, 1851, Oersted was a member of the Paris Academy. He was a very cultured man and published many papers on the relation of the natural sciences to poetry, art, religion and oratory. As a mark of respect to this investigator he has been honored by naming the unit of magnetic reluctance the *Oersted*. Its relation in magnetic calculations corresponds to the unit of resistance, the ohm, used in all electrical computations.

$25.00 To Anyone Who Solves this Electrical Problem

We have been approached by the engineer of a large electric company to help them solve a knotty electrical problem. These people require a special form of circuit breaker which on account of drawing a very heavy current (about 15 volts and 10 amperes), causes a large arc at the point of contact. This they wish to eliminate and the best method they have found so far, is the one shown in our diagram and described below. The company is willing to pay $25.00 for the best suggestion that shall prove acceptable, made by any reader of The Electrical Experimenter who can solve the problem for them. The offer is absolutely genuine and the contest will be conducted as follows:



Are You Good on Scheming? Then Try to Design a Successful Interrupter to Take the Place of the One Here Shown, Which Must Break the "A" Magnet Circuit at High Speed Without Injurious Arcing at the Contacts.

There will be a board of four judges as follows: Two of the editors of The Electrical Experimenter will constitute one side, while two engineers of the electric Company will constitute the other side. This Board will read all letters and suggestions and will select the most satisfactory answer. The result will be published in a coming issue of The Electrical Experimenter and the winner is to receive $25.00 at once at the close of the contest.

This is the problem:

Electro-magnet "A" cannot be more than one-half inch in diameter and 2½" in length and must be unipolar; i.e., open core type with no iron yoke. The armature "B" to be attracted is of tool steel and must vibrate as quickly as a bell, traveling 3/16" distance. The frequency range must be from ten to above fifty vibrations per second. Size of solid core is one-quarter inch Norway iron. Voltage can be from 12 to 110. Amperage must be the very lowest possible so as to reduce arcing at interrupter contacts.

The Interrupter can be redesigned or improved on the following tests:

(1) It must work continuously three hours every day for six months without paying any attention to it or readjusting the device.

(2) It must have some kind of an arrangement so as to vary the vibration of the armature. The armature must vibrate as low as 10 to above 50 vibrations. It must also be of simple and rugged construction so as to withstand rough use and be compact.

The circuit breaker can either be redesigned or else the electro-magnet "A" in figure must be so proportioned that the current taken by its winding will be the minimum possible so as to prevent severe arcing between the carbon electrode "E" and the electrode "D" which can be made of any high fusing metal, carbon or alloy.

The main point to be considered in redesigning this circuit breaker is that the arc produced by breaking contact at the two electrodes must be reduced to such an extent as to prevent the rapid consumption of the electrodes D and E so that the apparatus can be used for a considerable length of time without giving it any attention whatsoever. In redesigning the interrupter or circuit breaker, it must be considered that the electro-magnet "A" which transmits its pulsating magnetic flux to the steel bar "B" acts against a pull of five pounds exerted by a steel spring as indicated in the diagram. The distance between the electro-magnet core and the steel bar "B" is one-quarter inch; a stop preventing the armature approaching the core closer than 1/16".

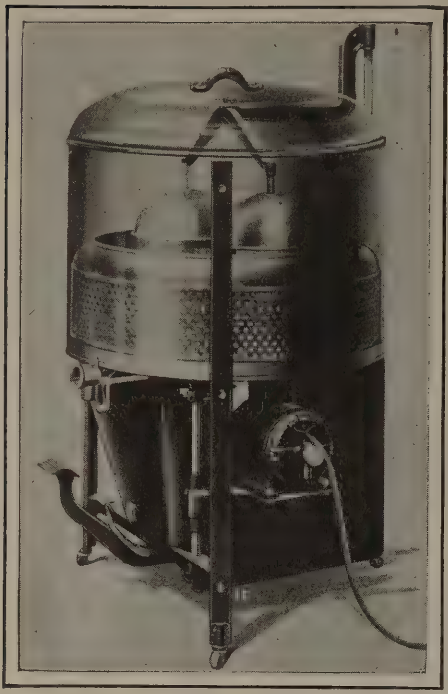
The party who is to receive this information from any of our readers (if it is satisfactory) becomes the sole owner of the idea. It is not necessary to offer any experimental evidence as to the working qualities of the proposed circuit or mechanism, but as long as the device or suggestion made to him is entirely *practicable* and *feasible*, a prize of $25.00 will be paid the successful contestant.

The suggestions and drawings must be made *clearly* and *concisely* and the exact size of the various parts, if drawings are forwarded to us, must be also given, so that we shall be able to form quickly the best opinion as to the working qualities of the individual suggestions.

(*Continued on page 282*)

UNIQUE ELECTRIC WASHING MACHINE.

An entirely new departure in electrically driven washing machines for the home has recently been placed on the market. This machine not only washes the clothes, but also dries them in the same tub without the housewife or laundress having to handle the clothes or immerse her hands in the hot soapy water.



Improved Electric Washer. Dries Clothes without Wringing.

The machine consists of two tubs, both of sheet copper, tinned on the inside to prevent corroding. The outside tub serves as a container for the washing solution, while the inside tub holds the clothes in position so that the vacuum cups or plungers cover all of the clothes in the tub. While these cups are working up and down the inside tub is slowly revolving so that every piece of material in the tub is thoroughly saturated and cleansed by the washing solution. The inner tub, which is perforated and sets about one inch above the outside tub, permits the washing solution to be forced through the mesh of the clothes instead of against the solid bottom.

The main feature of the machine, however, is the drying, as no wringer, either power or hand, is used. It requires from ten to fifteen minutes to thoroughly wash a tub of clothes, after which the vacuum cups are removed and the inner tub, which is perforated on the sides and bottom, is raised above the water to the drying position. It is then revolved rapidly, the perforations permitting the water to be forced out of the inside tub into the outer tub. An entire tub of clothes can be dried in this way in a moment; drier than they could possibly be wrung with a wringer. When the weather will not permit of clothes being hung outside the average flat work can be dried sufficiently in from five to ten minutes to place on the ironing board.

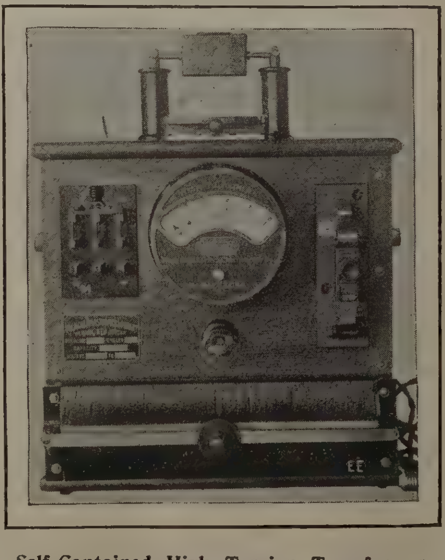
The operation of this machine, both for washing and drying, is exceedingly simple. The inside tub is immersed in the water or raised out of the water by means of a foot lever which locks in either position and when raised or lowered automatically connects or disconnects the washing or drying mechanism. The machine is friction driven, one lever controlling the drive for either the washing or drying process; for this reason a one-eighth horsepower motor is all that is required to operate the machine and on account of the friction drive all danger of overloading the motor or burning out connections is eliminated.

NEW 30,000 VOLT TESTING TRANSFORMER.

The latest product of one of the leading transformer manufacturers is here illustrated in the form of a 30,000 volt portable testing set. This outfit comprises a step-up, high potential transformer, capable of producing a maximum secondary voltage of 75,000 for dielectric tests on oil, insulating liquid, rubber gloves, insulators, insulated wire and cables, sheet insulating material and the like. The transformer is rated at 1 K.V.A. and is generally supplied for use on 60 cycle, 110 volt A.C. circuits. It can be readily lifted by two men and therefore it is adapted to a wide range of operations as it can be readily used on any laboratory work-table or desk. Moreover it is operated by simply plugging in on any 60 cycle, 110 volt lamp socket.

By means of the potentiometer supplied with the outfit and observed mounted on the lower portion of the switchboard, the secondary voltage may be varied from 0 to 33,000 volts. The secondary voltage is read directly by means of the voltmeter on the switchboard and which is calibrated to read in "kilo-volts." The transformer circuit includes a primary pilot lamp, which lights up as soon as this circuit is closed. The secondary connection may be changed from series to parallel to give various secondary voltages, by means of an oil-switch mounted inside of the transformer case. The whole transformer, including the windings, are immersed in oil, contained in a metal lined oak case.

For use in oil testing, an oil cup containing an electrode one inch in diameter is provided; the electrodes are the same as those used in 50,000 volt outfits of similar design. The small size of the cup enables a large number of samples to be tested with little waste. The adjustment of the electrodes in this case is accomplished simply by locknuts. When once adjusted this gap needs no further attention, it is claimed, and for this reason this particular part of the apparatus marks a distinct advance in the design over some of those now on the market. The contents of the test cup may be emptied out by revolving the cup on its axes, thus allowing the oil to run out into the tray below.



Self-Contained High Tension Transformer Testing Set.

ELECTRIC WREATH SIGN.

One of the latest electric signs on the "Great White Way" of New York City is the Gold Seal electric sign which is herewith illustrated. This spectacular electric wreath, although not the largest in its location, is one of the most interesting of the whole number.

Electric Sign of Unusual Beauty. The Leaves Change Color Successively.

This large sign measures 31 feet in height and is 56 feet long. Upon the frame the words "Gold Seal" are mounted and each are 3 feet 9 inches high and are formed of yellow colored lamps. The display, although it seems small from the street, employs 1,900 incandescent lamps to bring out the splendid effect attained. It is located at Seventh Avenue and Forty-second Street. Photo courtesy of O. J. Gude & Co.

NO DUTY ON WIRELESS.

A customs dispute between Collector Malone and Kennedy & Moon, dealing with the entry of complete wireless apparatus installed on the Government fleet of six Panama steamships, was settled recently by the Board of United States General Appraisers. A decision by Judge Hay held that no duty accrued on the outfits. Although the contracting firm complied with the regulations of the Treasury Department governing such importations, the Collector denied free entry, and took a 20 per cent duty under the tariff's provision for "manufactures in chief value of metal."

The Collector, at the trial before the board, stated that free entry was denied because the wireless apparatus was installed on old boats, and therefore, he maintained, excluded from the free privileges of the subsections of paragraph J of section 4 of the Underwood tariff law. The testimony showed that the new wireless outfits were imported and installed to take the place of other apparatus, which did not give good results.

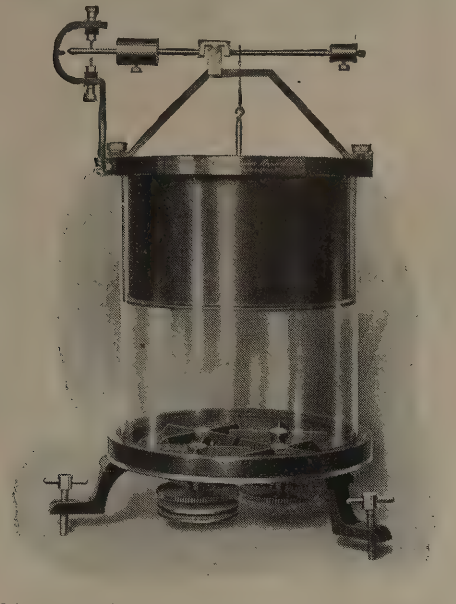
Judge Hay held that the wireless equipment was as much covered by the tariff's exemption clause as were boilers and engines.

FOR WIRELESS AT UNGA.

Senator Jones recently introduced a bill to establish a high power radio station at Unga Island, Alaska.

A Machine That Demonstrates Molecular Structure in Gases

One of the most interesting devices ever perfected is the Visible Molecule Apparatus, by means of which the various motions inherent in gases can be mechanically demonstrated. It was developed by Dr. Edwin F. Northrup of Princeton University, one of the foremost physicists in America.



This Motor Driven Mechanical Device Illustrates in a Vivid Manner the Molecular Action in Gases

The apparatus here described is believed to be the first mechanical model ever designed for fully and successfully illustrating, in a visible way, the motions of gas molecules and the principles which govern these motions as laid down in the kinetic theory of gases, and for the verification of some of the theorems of this theory with quantitative measurements. It is an apparatus which pre-eminently demonstrates the rigid laws of statistical mechanics. The molecules of a gas are visibly represented by 16,000 steel balls one-sixteenth inch in diameter, which are maintained in motion in a manner which closely simulates the motions of gas molecules.

The apparatus consists essentially of a circular metal base, supported on three legs with leveling screws, on which rests a glass cylinder with open ends. The glass cylinder is approximately 25 cms. high and 22 cms. in diameter. A metal ring rests upon the top of the glass cylinder. Various attachments can be made to this ring. When the apparatus is used for illustrating the motions of gas molecules and the pressure produced on the walls of a container by molecular impact, there is suspended from a crosspiece attached to the metal ring a floating disc of *glass.* This glass disc is capable of free motion, in the manner of a piston-head, within the glass-cylinder. The glass disc is ordinarily located a little above mid-way between the bottom and top of the glass cylinder.

In the volume enclosed by the glass cylinder between the base piece and the floating glass disc, approximately 16,000 steel balls are maintained in motion in the manner of gas molecules. The distribution of the balls throughout the volume in which they move is perfectly uniform. The motion of the balls is produced by means of four metal rotors. These rotors rest upon the metal base and rotate, two in a clock-wise and two in an anti-clockwise direction. Their plane of rotation is the horizontal plane of the metal base-piece and it is by the impacts of the rotors upon the flying steel balls that these latter are maintained in the motion described. The apparatus when assembled to illustrate and demonstrate change in pressure, at constant volume, of a gas when the temperature changes, is here illustrated.

The rotors are maintained in rotation with power derived from a small shunt wound, direct current motor. Underneath the steel plate there are four inter-acting gear wheels to which the rotors are attached and a pulley for belt attachment to the motor.

By means of the scale arm, provided with sliding weights, which appears in the illustration at the top of the apparatus, the pressure exerted upon the floating disc by impacts of the moving steel balls may be accurately measured. Moreover, by means of two electrical contacts provided on the device, and between which the balance arm plays up and down, it is possible to control suitable rheostats in the driving motor circuit, so as to obtain approximately constant speed. This is very essential in some of the experiments performed with this apparatus.

The instrument with its accessories gives a striking and convincing visual demonstration of the following fundamental properties of a nearly perfect gas:

1. The change of pressure of a gas, when the volume is maintained constant and the temperature changes. 2. The change of volume of a gas at constant pressure with change of temperature. 3. The property known as the viscosity of a gas—a property which is exhibited in all gases when the oscillations of an oscillating system suspended in a gas are damped out. 4. The property possessed by a gas (and a liquid) of causing a higgledy-piggledy motion of small particles suspended in the fluid, known as the *Brownian movements.*

In addition to these fundamental experiments a large number of other experiments, some of which are quantitative in character and which can be used as tests of correctness of several of the corollaries of the kinetic theory, can be performed. Thus, the number of impacts, corresponding to a given speed of the rotors, per second per unit area can be determined.

Dr. Northrup has found that, used in the proper way when the weather conditions are suitable, the apparatus may be made to develop some interesting electrostatic effects. These effects can be obtained in a variety of ways and sparks one-half cm. long may be obtained. This use of the apparatus is only incidental however.

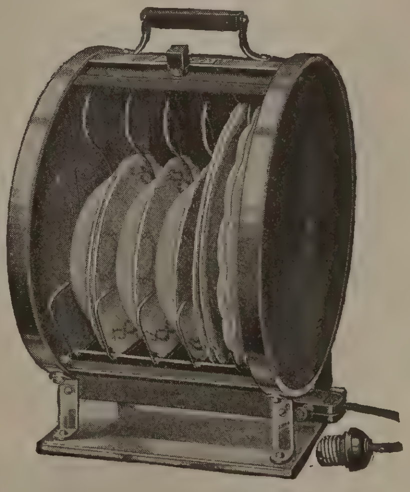
When the apparatus is operating, the distribution of the balls is perfectly uniform, and though each individual ball has a speed unlike that of any other, the mean square velocity of all the balls bears a perfectly definite relation to the speed of rotation of the rotors, and this means square velocity of the balls represents what corresponds to the absolute temperature of a gas.

To render the effects strikingly and beautifully visible an incandescent lamp is suspended inside the metal cylinder just above the floating disc and the room partially darkened. The motor is then started and its speed gradually increased by cutting resistance out of a rheostat in series with the motor, until the balance-arm at the top floats between the upper and lower stops. To maintain the balance-arm floating it is necessary to make constant adjustments of the rheostat, special connections as aforementioned are used, because the pressure on the disc is exceedingly sensitive to very slight variations in the speed of the rotors. When there is a given number of balls in the apparatus and when the weights on the balance-arm have the same positions, exactly the same pressure is always produced with a given speed of the rotors.

Every ball is in motion, flying about from point to point in space in the precise manner assigned to the motions of molecules of a gas in the kinetic theory of gases. The distribution of the steel balls throughout the space included between the base and the floating glass disc is strictly uniform as far as the eye can judge, and while no two balls have at a given instant the same direction or velocity of motion, the average velocity of all the balls is constant when the speed of the rotors is constant. It is a case of statistical mechanics which enables resultant effects to be predicated though the movements of individual units are wholly fortuitous and without possibility of being followed. Such an apparatus is of marked value as an aid in instructing students as to the actions taking place in gases under different pressures and conditions.

WARM YOUR PLATES BY ELECTRICITY.

How many times have you wished for an efficient plate warmer for use in the kitchen or butler's pantry? Here is just the device you have been waiting for. Plug in the cord attached to it and your cold plate troubles will cease. The new apparatus is compact and light enough to be useful in the bungalow no less than in larger establishments. It consists essentially of a nickel-plated Russia-iron cylindrical drum 12 inches in diameter, 9.5 inches wide and 17 inches high over all, with heating coils in the lower portion and equipped with a slide and plate rack holding ten to twelve plates. The plates rest on their edges, any one of which can be removed as desired. In ten minutes' time the device full of plates can be warmed up nicely at a cost of about 1/20 of a cent. Once heated, however, the warmer retains its heat for about an hour after the current has been shut off. All the plates are heated evenly in this way, a decided improvement over the old style method of stacking a pile of dishes in an oven, with the result that they are all invariably heated to various temperatures, ranging from 85 to 185 degess Fahrenheit. The heater is very light, weighing but ten pounds, and the initial cost is quite nominal.



Electric Plate-Warming Device

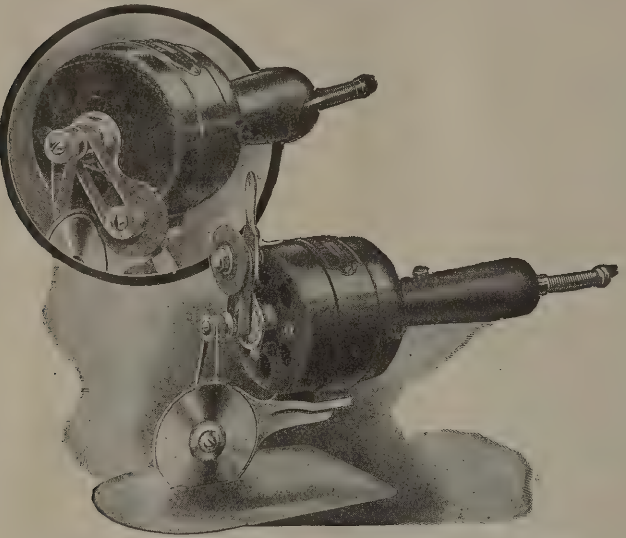
CHILDREN IN ILLINOIS TOWN TAUGHT TO READ METERS.

Pupils in the grade schools of Freeport, Ill., are taught how to read gas and electric meters and figure out how much the bill will be. This subject should be taught in every public school.

AN ELECTRIC CLOTH CUTTER FOR TAILORS AND DRESSMAKERS.

One of the largest elements in the tailoring cost of a suit of clothes, overcoat or other garment is in the cutting of the goods; the cutters are high-priced men who are experts in laying out and cutting the cloth to the best advantage. This is true of clothing manufacturers and dressmakers as well as of custom tailors. Therefore anything that facilitates the work of the cutter is in the line of efficiency and reduced production cost. A means of improving the efficiency of the cutter is by relieving him of the burden of actually cutting the goods by hand with tailor's shears or knife.

To meet the evident need of smaller shops and of all tailors for a machine that would cut one, two, three or so layers, in contradistinction to the larger cutting machines used for cutting twenty or more layers, there has been now placed on the market a handy electric appliance especially designed for this purpose.


Electric Cloth Cutter and Method of Sharpening It. Latest Adjunct to Tailoring and Dressmaking.

The machine is compact and light in weight, making it easy to handle. It is equipped with a small universal motor that can be operated on either direct-current or alternating-current circuits and takes only a very small current. It operates at a speed of 6,000 revolutions per minute. Through a belt it drives the cutting wheel. The blade edge of the wheel has a razor-like edge, which is easily maintained in perfect condition by grinding it now and then with a special emery wheel forming part of the outfit.

The main part of it is shown turned up in the insert at the upper left corner, the emery wheel being shown turned down against the cutting blade so as to grind it to a hollow-ground edge.

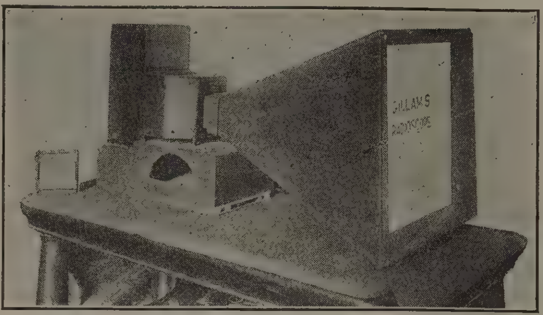
TROUSERS CREASED ON THE PERSON

By H. E. Zimmerman.

Joseph Jeannetand of Dubuque, Iowa, has invented an arrangement by means of which trousers can be pressed while still on the wearer. This apparatus, operated by electricity, will also press hats, ladies' dresses, coats, ties, and almost any other kind of wearing apparel. It can be dropped into a pan of water, heating it very quickly. The device consists of two little cylinders about one-half inch in diameter, which are so arranged that when not being used they are in contact. They are held in place by powerful springs, so that when anything is placed between them to be pressed a pressure will be exerted on the article. The cylinders have a layer of brass around them, and in each cylinder is a coil of No. 44 resistance wire.

This Electric Hand Mangle Presses Pants While You Wear 'Em.

A DAYLIGHT PICTURE PROJECTOR FOR STORE WINDOWS.


This Electrically Operated Show Window Attraction Throws Ever-changing Views on the Screen at the Right.

An advertising device known as the Radioscope, is one of the latest electrically operated show window attractions. This device is designed to call the attention of shoppers to bargains and other good things that they might otherwise miss in a large shop on a busy day. It will project in the ordinary daylight of a store, or under the electric light, any print, writing, picture or fabric that may be put in it. The pictures appear as on a moving picture screen, one exhibit following another automatically as prearranged. Any number of holders, from three to twelve, may be inserted in the device, and the advertising effects made to appear in sequence with set times for both exposure and intervals between exposures. Any holder or holders may be removed at any time and new ones added while the device is in operation.

The holder accommodates matter of any shape up to 6 inches square of surface. The enlargements range from 16 times for a screen 2 feet square, to 144 times for a screen 6 feet square. The length of dark chamber required for a given screen area varies from 6 feet for a screen 3 feet square, to 12 feet for a screen 6 feet square. The projecting and changing apparatus is of standard size, about 20 by 15 inches and 22 inches high.

It is operated by means of an attachment plug connected with the lighting socket and is automatic. The only changes necessary are those needed to give variety to the pictures.

The machine is used by railroad offices in prominent locations to show the public some of the beautiful scenery existing along certain routes; by real estate agents, as an aid in selling houses, property, etc., and by many stores, dealers, specialty houses and theaters.

USE AN ELECTRIC RANGE DURING THE HOT WEATHER.

After fourteen years of very extensive and exhaustive investigation and research to discover the most efficient method for the application of electric current for cooking, the engineers behind the "Hotpoint" electric heating line have concluded that the open-coil reflector type heating element is the most desirable from every standpoint of efficiency.

The next problem was to design a supporting frame sufficiently durable and that would absorb a minimum of the heat units developed by the heating element proper.

In order to obtain a maximum of durability with a maximum of efficiency these stoves have their new heating element constructed of steel and porcelain imbedded in steel, in a truss form of construction that makes for rigidity and absorbs a minimum of heat. This glowing coil reflector type of heating element of porcelain and steel is known as the Reflex Burner.

An Electric Range of New Design for the Small Kitchen.

The working temperature is reached within fifteen seconds after current is applied and an element wound for 1,500 watts with a diameter of not more than 8½ inches approximates the modern-sized gas burner in the period required to heat up; something which has never before been accomplished with an electric range.

The arrangement of the burners on the surface of these ranges is such that these burners or elements are quickly and easily accessible. The reflector plates, by a novel arrangement, rest on the crumb tray which pulls out the same as a crumb tray on the ordinary gas range, when the reflector plates can be lifted off. The fact that there is a space of approximately one inch between the coils and the reflector plate makes it impossible for food to accumulate around the coils, thus minimizing the danger of disagreeable odors and the risk of coils being subjected to excessive temperatures and consequent break down through lack of air circulation.

If repairs at any time should prove necessary, the element is easily removed by taking out three screws which make the electric connections. Each reflex burner is controlled by three-heat indicating snap-switch. All models are finished in black enamel. The ovens of four of the types supplied are lined with aluminized steel and high-grade mineral wool is packed between the walls.

Those Electric Light Bills and How the Housekeeper Can Reduce Them—An Article for Father and Mother.

By F. H. Sweet

IT is the prerogative of every good citizen to grumble, and there is no more fertile source for a grumble than an electric light bill. The average citizen knows positively that he has not burned the amount of light charged and he feels, at best, that he is in the hands of a soulless corporation and that there is a fiendish machine in his cellar whose particular duty is to mark up "unknown quantities" of electricity; always to the advantage of its owner—the Electric Light Company.

It is the intention of the author to try and put the average citizen straight and to show him how he can cut down his bill and at the same time accomplish his purpose of lighting his home, residence or factory.

It is a fair proposition to say that no corporation can systematically cheat all the people, all the time, and get away with it. The Electric Light Company comes under this law and desires to furnish you with service for a consideration, of course, from which the company may earn a profit for its stockholders. You, on your side, want your particular premises lighted up at any and all times according to your ideas of what is light enough.

Now the company, so that it may know how much of its product you consume, puts a meter in your house and here comes the first grumble. It is not the intention of this article to go into a scientific discussion of meters—it is sufficient to say that if you doubt your meter have it tested by the company. It will probably report it correct and the chances are twenty to one that it is so. If it is not correct an allowance should be made for all the time during which this meter has been in service.

The company is not responsible for affairs on the house side of the meter, so we will proceed to consider them with this view.

The first thing is to look for leaks in the system, these are known as "grounds." You can detect them, if they exist, if you examine your meter, say the last time at night after all the lights have been extinguished, read the dials and see that the meter registers the same the next morning; if it does not, the wiring of the house needs attention and, in fact, must be attended to, for grounds are often sources of fires. After you are satisfied that there are no leaks, the next thing to take up is your switches.

The system of having all the light in a room controlled by one switch is a most prolific source for wasting current. A person enters a room to get a book, or on some similar errand; there may be five or six lights in the room. The switch is thrown and all the lights go on, when ordinarily one light would be sufficient. If the person remains in the room five minutes the result would be the same as if one light burned half an hour, six lights burning five minutes being equal to one light burning half an hour.

If your wiring is controlled by switches only leave on the lights absolutely required; turn the others off either by the key in the socket, or if this key does not exist, unscrew the lamp so that it will not burn.

Some of the lights in the house burn continuously. These are the current consumers and must be carefully considered. A light for a small space must not necessarily be a big light. Lamps as generally used are made in three commercial sizes, viz: 16, 8 and 4 candle power. The current they consume is approximately proportional to their candle power. Where lamps burn continuously cut down the candle power and you will save current. Suppose that you have your closets arranged so that when the door opens the light goes on. This is convenient—for lazy people, but suppose the door of the closet is not closed the light will burn all the time that it is open and your bill swells correspondingly. Do not put a 16 candle power lamp in that closet, put in an 8 or a 4. And be sure to use Mazda tungsten lamps; they use but half the current of carbon lamps. When a lamp is brown and dark on the inside its usefulness is over and it will only consume current without yielding proper results.

As an illustration of the energy one lamp will consume, let us suppose that a lamp burns twenty-four hours. The current used by this lamp would be the equivalent of twenty-four lamps burning one hour, and twenty-four lamps would give quite an illumination.

Old lamps which have survived their usefulness are *current consumers* and should be replaced by fresh lamps.

Here is a brief summary of the entire matter:—

Make sure that your system does not leak.

Turn your lamps on at the socket, not at a switch controlling groups of lamps.

Only use lamps of sufficient candle power for the service required, and have them Mazda.

Replace old lamps, when discolored, with new ones.

Make sure that your meter is right. Do not, however, have it tested until you have made sure of the above points.

If you follow these suggestions you will cut your bill materially. Remember that the Electric Light Company is only trying to make a fair profit for its stockholders, who may possibly be your neighbors, and that its president may attend the same church that you do.

So try these very simple suggestions and see if the results do not amply repay and satisfy you.

A PHOTO-ELECTRIC RELAY.

The phenomenon accompanying electrical discharges through gases takes many forms, among which we might mention the Audion for wireless telegraph reception, the phenomenon of the Crookes' tube, including the X-rays, the new De Forest Audion piano and the Kenotron tube which attracted so much attention during the recent tests with long-distance radio-telephony.

The new photo-electric relay acts on the principle of varying discharges through a gas, and the discharge is controlled in this case by illuminating one of the electrodes.

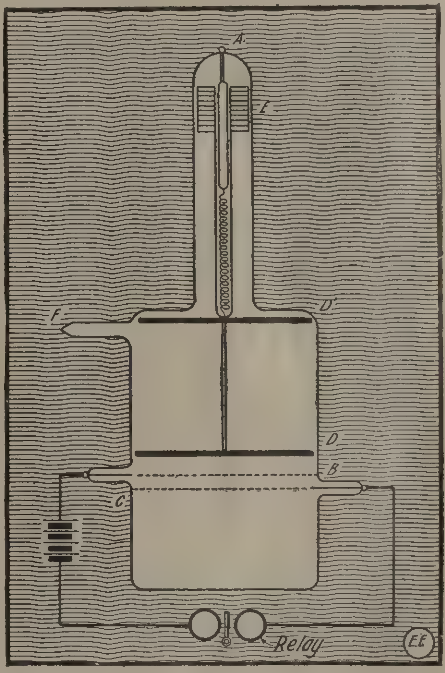
The apparatus as shown in the illustration herewith consists of a glass tube 2½ inches in diameter and about three times as long, as described by J. Kunz in *Electrical World*. Mounted in this tube are two wire nets or grids, indicated at B and C. These are connected in the circuit to be controlled, and in most cases this takes the form of a sensitive relay which controls a secondary circuit.

In the upper end of the tube is an electromagnet acting on the sliding iron plunger which is connected to the aluminum plate D. The distance between D and the grids can be easily varied by means of this magnet and thereby controlling the sensitiveness of the relay.

After assembling the tube a little rubidium is distilled in the vacuum through the side tube F on the plate D, which in this way can be uniformly covered with the alkali metal. Hydrogen is then admitted and the surface of the alkali metal made sensitive by means of a glow discharge. The hydrogen is to be replaced by argon until the sensitiveness is at a maximum.

The operation of this relay is as follows: The light from an incandescent lamp or other source passes through the two wire nets B and C and, acting on the rubidium-hydrogen compound, liberates electrons. These electrons move under the influence of a small potential difference from D to the nets and enter the electric field between C and B. The voltage between C and B is about 136 volts and the space between will be more or less electrified. The electrons ionize the gas between the two grids by collision and thus reduce the resistance. Through this operation the current flowing between B and C becomes strong enough to operate a relay connected in the circuit as shown. The apparatus may be adjusted to its most sensitive point by means of regulating the distance between the aluminum plate D and the grids and by varying the voltage between the terminals C and B.

In the course of experiments conducted in the physics laboratory of the University of Illinois the distance between B and C was kept constant about .2 inch, and while the distance between B and D was varied from about .1 inch to 1.1 inches, the maximum secondary current was sufficient to close an ordinary relay when the voltage was 136, as previously stated. If the voltage is raised beyond this limit a glow discharge takes place in the tube, which destroys its sensitiveness temporarily.



New Photo-Electric Relay, Which, When Acted Upon by the Light from an Ordinary Incandescent Lamp, Will Close an External Magnetic Relay. The Light Passing Thru Wire Nets B and C Acts on a Rubidium-Hydrogen Compound, Liberates Electrons, Which Ionize the Gas and Thus Reduces Its Resistance.

This apparatus can be used for an ordinary electric relay when connected according to the diagram, and has quite a wide field of usefulness. Among many of its uses may be mentioned the fact that it will detect electro-magnetic waves by connecting the terminal A to the circuit, or as a telephone relay for very weak electric currents when the terminals of the line are connected to the points A and C. As the apparatus is sensitive to light, it will no doubt, in a modified form, take the place of the very unstable and unreliable selenium cell.

Electric Shocks and How to Avoid Them

THE interest in fatal electrical shocks and their avoidance has recently been brought vividly before the public by the case of Mr. C. Frederic Purick of Port Jefferson, L.I., who lost his life accidentally by touching an electric socket in his home while taking a bath.

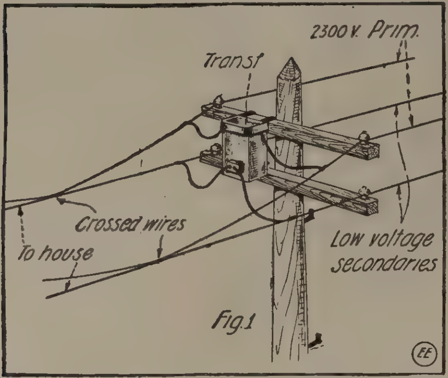


Fig. 1. Showing How High Voltage Wires May Drop onto Low Voltage House Service Lines, Thus Charging the Latter to a Dangerous Potential. This Cause Was Responsible for the Death of Mr. C. F. Purick of Port Jefferson, L. I.

To begin with, the subject of electric shock is one of wide scope and one that has proved the bone of contention in more arguments possibly than any other ever brought up among electricians of all classes. Whether or not a potential of 110 volts, such as that used for ordinary lighting circuits, can prove fatal to human life has been and is a mooted question.

Much expert evidence has been given on this matter, but there appears to be room in most cases for diverse opinions as given by authorities on the subject, including those of the medical profession, due to the fact that all persons are not alike in their physical make-up; i.e., their nerves and hearts, and physical condition differ widely.

It may be said for one thing that practically all electricians think nothing of touching with their fingers a 110 volt or 220 volt A.C. or D.C. switch to ascertain whether it is alive or not. It is often the case, as the author happens to know from personal experience, that the current may pass harmlessly through the hand down through the body and out the feet, as for instance when a person making such a test happens to stand on the ground or in contact with a grounded conductor such as a water, gas or steam pipe. On the other hand it is claimed in a number of authentic cases on record that 110 volts has sufficed to produce fatal results to a human being. Therefore it behooves everyone to take the utmost care in handling electrical apparatus of any nature, no matter whether it is a small toaster or an innocent looking electric light switch of the push button variety.

In the case of Mr. Purick, presumably, he must have stood in the bath tub partly filled with water and thus made excellent electrical contact on the lower limbs. It is believed that his head came in contact with an overhead lamp socket which ordinarily, of course, carried but 110 volts. There were many arguments brought up at the coroner's inquest in the matter and the officials of the light and power company supplying the locality tried to prove that the transformer on the pole outside of the house was in first-class condition. This matter can be cleared up briefly by recounting the evidence given by Mr. George Sever at the request of the Coroner. Mr. Sever, a consulting electrical engineer of New York City, was formerly Professor of Electrical Engineering at Columbia University. He testified:—

"On the cross-arm was an old-fashioned fuse-box which was only supposed to carry 800 volts, but which was used for 2,300 volts. It should have had two fuses in it, but instead only had one and this was too large to afford any protection to the transformer. There was no trouble with the transformer. The full primary voltage went into the house. The wiring was 'shorted' on the pole in some way, so that the transformer did not step-down the current. The lead-in wires were subdivided into two services, one for the lower floor, the other for the upper. Each service had a pair of fuses in it. When Mr. Purick's head came in contact with the fixture, thus making a complete circuit with the bathtub, one pair of 6 ampere fuses and all the lights on that floor were blown out. Therefore, the full primary current of 2300 volts passed through Mr. Purick's body."

An illustration is given herewith (Fig. 1), showing how the primary and secondary wires could have sagged and thus become crossed, in this way eliminating the transformer entirely from the circuit. Hence the 2300 volt primary current would pass over the secondary wires into the house, and since only an 1800 volt potential is used in penitentiaries for electrocuting criminals, it can readily be seen that a person has but a slight chance of surviving a 2300 volt shock.

To sum up the matter, those having electric lights in their homes should always exercise the greatest care in manipulating any of the devices connected to such service. They are practically immune from danger if they would just take the trouble to see that they *always stand on a dry floor.* In the bathroom especially they should *never touch the socket or wall switch while standing in the bathtub, or with wet feet on a floor where there is any water*, as these accidents happen at the most unexpected moment. A good point to keep in mind would be to exercise extreme caution in manipulating all lamp sockets or switches during or directly after a severe storm, which may have blown down high voltage wires so as to cause them to drop across low tension wires supplying house circuits, as in the regrettable case aforementioned.

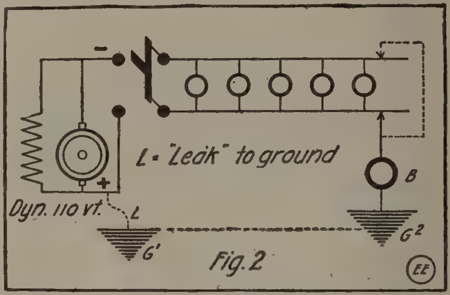


Fig. 2. Causes of Low Voltage Shocks Due to Accidental "Grounds" at Two Points on the Line.

While on the subject it may be of interest to mention a much misunderstood problem as to the reception of shocks from *ungrounded* electrical distribution systems. This matter has been discussed of late in several of the leading electrical journals and we do not intend to go into details here on the more complicated aspects of this problem, where extra high voltages are involved in the high tension circuits of distributing transformers and the like, as it seems that it is possible for a person to receive a shock from such a system when there is no direct metallic ground connection between the primary and secondary wires of the system and the earth. This is undoubtedly due to the heavy leakage at some point along the circuit, which permits enough current to leak to the earth so that when a person touches a ground connection and one of the circuit wires, he receives enough current to give him a severe shock.

The point is that anyone is supposed to receive more of an electrical shock from a 110 volt potential, when he happens *to touch an iron body or an earth connection* with the other hand. Referring to the second illustration (Fig. 2) this point is brought out very clearly. The system here outlined is a common one, such for instance as that used in many isolated lighting plants, involving the utilization of only low potential 110 or 220 volt current. Now if this system has no *ground* connection at the dynamo end of the line, it is impossible for one to receive a shock by touching one of the circuit wires and the ground, the body being indicated at B. If, however, a *ground leak* should occur at L, then a person (represented at B) would obtain a shock of 110 volts by touching the opposite wire of the circuit at any point along its length.

In many instances where people meet with fatal results from touching such a crossed electric circuit as that mentioned above, they receive the full *primary current* owing to the transformer breaking down (Fig. 3). In this event, supposing that the primary is grounded for lightning or other protection, then when a person makes connection from the secondary circuit to earth by touching a lamp socket or switch plate, the primary potential will likely pass through him. Many freak accidents of this nature have gone on record where people have not been killed, even though receiving from 2000 to 2500 volts and even more. This is generally due to the peculiar manner in which the current happened to have passed through the body. Again it may be due to the difference of resistance of the body and that of the skin particularly.

In this direction the following figures may be of some interest. Tests were made on a young male by means of a Wheatstone bridge and those mathematically inclined can figure out approximately about what current would pass through a similar body having such a resistance, keeping in mind that ¼ or ½ ampere through the heart is said to be sufficient to arrest its action. The resistance measured from hand to hand dry was 7000 ohms. The resistance measured from one hand to one foot dry was 9000 ohms. In the latter test the foot rested on a piece of tin. With wetted hands and holding two large tube electrodes therein, the resistance through the body from hand to hand measured 5000 ohms. The resistance of persons varies greatly within certain limits and the author has known of this value dropping as low as 4500 ohms in some instances and reaching a value as high as 33000 ohms. The average, however, is about 15000 ohms from hand to hand (dry test).

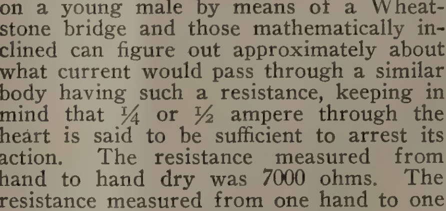


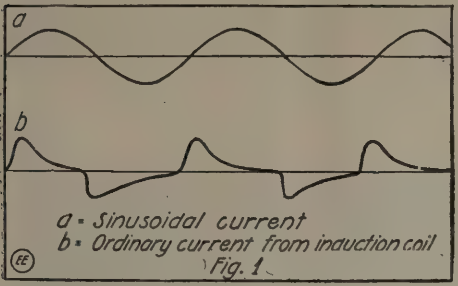
Fig. 3. When a Step-down House Service Transformer Breaks Down Between the Windings at X¹ and X², the 110 Volt Circuit is Charged with High Voltage Current.

The Marvels of Modern Physics

By Rogers D. Rusk, B. Sc.

Electricity and Medicine.

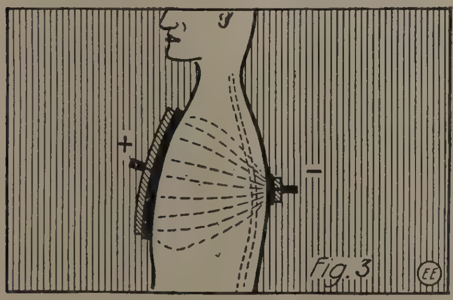
THE sciences of physics and medicine have at last joined hands across the gap which separated them for ages. In centuries long past the only natural forces which were believed to influence the body were perhaps the stars, or some amulet or charm, but that was long before the discovery of electricity. In 1786 Galvani noticed the twitching of the frog's leg which hung in contact with two dissimilar metals, and which was caused by the current between them. Since that time the physiological effects of electricity in its different forms have been deeply investigated, and the separate science of electro-therapeutics has sprung up. Not alone electricity but also light in different ways has proved of much use in treating the many diseases to which man is heir.



Difference Between a Sinusoidal Current and the Unsymmetrical Alternating Current from Common Induction Coil.

Many of the facts of electro-therapeutics should be matters of general knowledge for at least two reasons. Unscrupulous impostors do not hesitate to exploit the innocent sick for financial gain, and any facts which would prove of general benefit to society should be spread broadcast. A few years ago electricity in its different forms was hailed and advertised as a *wonderful* cure for diseases of every kind from the greatest to the smallest. Many of the statements were most absurd. "Bottled electricity" was advertised to be a positive cure for consumption, although the dose in spoonfuls was not specified. Certainly the person who would bite at such bait would fall in the same class as the farmer in the middle west who was approached by a well dressed stranger and induced to buy a "thousand volts" with which to spray his trees. Notwithstanding these amusing and obvious frauds, and notwithstanding the fact that electricity has failed to be the cure-all or fountain of youth it was hoped for, a great many diseases may be beneficially treated if not permanently cured by it.

There are in general three forms in which electricity is used to treat disease:



In Applying Galvanic Current (Low Potential) Various Effects Can Be Obtained by Using Different Size Electrodes.

(1) The galvanic current is the ordinary direct current from a battery which is used for therapeutic purposes because of its power to cause chemical decomposition.

(2) The faradic current is the interrupted current produced by an induction coil, which acts for a short time as a powerful stimulant, or for a longer time as a sedative or anaesthetic.

(3) Static electricity acts as a tonic to the circulatory and nervous systems.

We know by experiment that a current carrying electrode applied to the region of the eye will produce the sensation of light. If placed at the ear it will temporarily relieve deafness. Currents may produce numbness, or some chemical change, or merely physical stimulation. In order to classify these effects on the body three more terms are used:

(1) Electrolysis is the chemical decomposition of a compound substance due to the passage of a galvanic current.

(2) Phoresis is the property which a galvanic current possesses of driving medicinal substances in solution into the body.

(3) Catalysis is the peculiar effect on the vaso-motor system by which nutrition is either accelerated or retarded.

From this it is seen that the subject of electro-therapeutics demands a preliminary knowledge of physics, chemistry, physiology and psychology.

An improved faradic current is now much used, which is called the *sinusoidal* current. This is an induced current whose potential rises and falls gradually as shown in Fig. 1 (a), and does not make the sudden and jerky variation that the ordinary induction current Fig. 1 (b) does. Applications of this current are not painful as it does not give the unpleasant, *sharp* jerking to the muscles, given by the other. After a frequency of 5,000 complete alternations per second is reached the muscular contractions decrease, and at 25,000 alternations per second a current passing through a portion of the arm will completely deaden it so that pins may be pushed through the flesh without being felt. It seems that the sensory nerves, when subjected to this current, lose the power of transmitting sensations, and this fact has even been made use of in dentistry in the extraction of teeth. Some experiments were made not long ago in which complete anaesthesia was produced by an electrode attached to the head. Either a light or deep sleep was produced by varying the strength of the current.

THE subscription price of this publication will be raised from $1.00 to $1.50 in a very short time. See our announcement in the July issue. If you wish to save money, now is the time to subscribe at the old rate: $1.00 a year, $2.00 two years, etc., and $5.00 for five years. (Foreign and Canadian add $0.50 per year for postage.) If you are a subscriber you will profit by extending your subscription for one or more years. No subscriptions accepted for a longer period than five years. ACT NOW, before this chance is gone.

A complete list of the suggested treatments for various diseases would make a good sized book of value only to the physician, but a few ailments which have been successfully treated may be mentioned here to emphasize the most important uses of electricity in medicine.

In chronic rheumatism, lithia or soda salts may be applied directly over the point of affection with the galvanic current. In any case repeated applications of static electricity bring decided relief. Paralysis is often cured by an application of the negative galvanic current, as this acts as a stimulant and stirs the sluggish inactive sensory nerves. In neuralgia, lumbago and numerous pelvic disorders, the sinusoidal current acts as a nerve tonic, and with the galvanic current often affords complete relief. It is claimed also that the frailties of old age resulting from hardening of the arteries (*arterio-sclerosis*) may be temporarily relieved at least by placing the patient inside of a huge helix or cage and subjecting the whole body to the electromagnetic currents within the coil. The cage shown in Fig. 2 is patterned after one made by D'Arsonval, the celebrated French scientist.

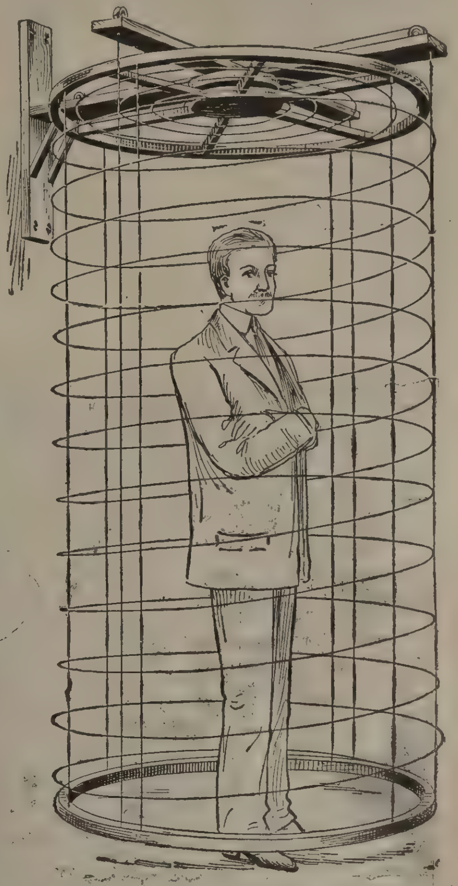
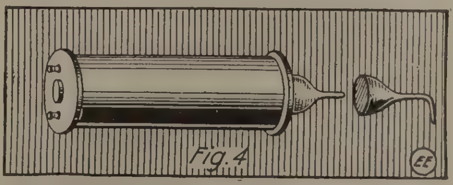


Fig. 2. For Many Ailments Beneficial Results Are Obtained by Placing the Patient in a Wire Cage Thru Which High Frequency Current Surges.

The removal of warts, moles and superfluous hair by electrolysis is too well known to need much discussion. In such work care must be taken to use the proper pole, as the two poles give exactly opposite effects. The positive pole collects acids, liberates oxygen and constricts the blood vessels. The negative pole collects alkalies, liberates hydrogen and dilates the blood vessels. The needle in such work must be



The Physician Finds the Electromagnet to Be Extremely Serviceable in Removing Steel or Iron Particles from the Eye or Flesh.

(*Continued on page 287*)

The "Wireless Wiz" Turns Detective

By Thomas W. Benson

"I'M up against a real job this time," soliloquized the "Wiz" as he deftly fashioned the makings into a nail. It was pretty late and his conversation having reached the monosyllabic stage indicated fatigue or deep thought. The latter being the more probable since he had just accepted a proposition somewhat out of his usual line.

The neighborhood had, of late, been flooded with counterfeit half dollars. They were more than imitations, for it was extremely difficult to detect them, in fact they were every bit as well made and clear cut as the legal tender. The common tests had all failed, and storekeepers were unaware of their loss until the bank politely informed them that on assay the money was valueless. The exquisite workmanship employed was apparent by the sample the "Wiz" had just shown me.

McDuffy, Captain from Police Headquarters, had been in to see the "Wiz," and being aware of his ingenuity, had suggested that he make a try at locating the plant of spurious coin. Daredevil that he was, the "Wiz" eagerly jumped at the chance and no inducement was offered other than the glory and publicity given the hero.

"Guess I'll sleep over the question," yawned the "Wiz," "drop in to-morrow night and I'll have some plan of action doped out," he finished, kicking his shoes under the table in a manner that indicated the end of the interview.

It was really laughable to think of the stuff that this boy tackled of late with such *sang-froid*—nothing seemed to daunt him in the least. The present occasion was no exception to the rule and true to his word he soon had a plan of action for detecting the passer of the spurious coins.

". . . . But why not melt the chains off? . . . . Quick as a wink he pressed the handcuffs against the switch blades. A splutter and flash as they touched the metal, and the cave was in darkness."

He made two coils of wire, each 3 inches in diameter wound on a cardboard tube and so arranged as to allow of adjusting their distance apart. Two other coils were placed in inductive relation to each other and a buzzer, battery, push button and sensitive galvanometer completed what was one form of *Hughes Balance.*[*]

We took the completed apparatus to a large local grocery and installed the coils under the counter. The battery and muffled buzzer were placed along with the other two coils on the floor. The push-button was mounted conveniently under the counter with the galvanometer beside the cash drawer.

A good half dollar was laid on the counter over the coils, the buzzer was then operated and the relation of the coils changed till no deflection on the galvanometer was noticed. The "Wiz" now placed a counterfeit coin in the same position as was occupied by the good one. On pressing the button a decided deflection was noticed.

The "Wiz" explained the operation to the storekeeper and showed him how to use it without causing suspicion on the part of customers, since it might drive the honest people away if it became known that their money was being tested.

"Remember," cautioned the "Wiz," "I don't want the man who passes the coins; I want the gang, so in case you get a bad coin call me on the phone immediately and watch which way the criminal goes and get a good description of him."

"This watchful waiting stuff gets on my nerves," gloomily ejaculated the "Wiz." as for the sixteenth time he tried to be interested in the magazine before him. We were rather strung on edge and every time the phone rang the "Wiz" was right on the job, only to turn in despair to call Sister Olga to answer.

"Cut it short, sis, cut it short," he would growl at her if she started to murmur sweet "coo-coos" to her affinity stationed on the other end of the wire.

Nothing happened that night, but the following morning the "Wiz" was brought suddenly to his senses when he had drowsily answered the phone to be told that a boy had just handed in a counterfeit coin.

Less than two minutes later our breathless Wizard had the details and was after the boy. But two minutes is long enough for many things to happen; in this case the trail was lost.

"I'll have to stay here with you I suppose," the "Wiz" explained to the grocer, and the customers were all delighted with the new clerk, who, it must be admitted, was rather slow at times in making change.

The testing of half dollars was becoming almost an automatic action, so a deflection on the meter almost went unnoticed. The "Wiz" started, looked again and true enough that little black finger jumped every time the button was depressed.

He made change rapidly and as the customer passed through the door the "Wiz" was already slipping into his coat. It was easy enough to follow the suspect, a man of thirty, more or less, rather heavy build with a peculiar motion of the hips as he strode along.

Breaker and shadow, at a distance of fifty feet apart, walked for five blocks and then the man turned quickly to the right and ran down a pair of steps.

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[*] See this month's "The Constructor" Department for the construction of a Hughes Balance.

"The boat landing!" muttered the "Wiz." "Wonder where he is going!" The land was not built up and a wide stream flowed through. A massive bridge carried the traffic over the river, which was a favorite boating place.

The "Wiz" saw the man push off and row under the bridge. Stepping to the other side of the bridge, the "Wiz" waited in the gloom for him to reappear, but after five minutes' time no boat had come from under the bridge. Retracing his steps the "Wiz" looked up stream, suspecting that the man had started down stream as a blind. But no boat was on the water, all being moored to the float at the bottom of the steps.

The "Wiz" ran nimbly down the steps, untied his canoe and sprang into it. A few swift strokes of the paddle and he was in mid-stream. Allowing the craft to drift he scanned the bridge closely and midway under it there was moored the rowboat.

The mystery deepened. Where was the owner of the craft? Drifting slowly under the bridge, the "Wiz" examined the concrete work closely, keeping an eye on the empty rowboat.

Suddenly it moved to one side, closer to the side and dimly in the darkening night the "Wiz" saw two legs protruding from an opening in the concrete work of the bridge. Quick as a thought he paddled his light craft from under the bridge and around one end of it.

To his ears came the quick dip of oars and a moment later the boat passed him, the oarsman looking neither to right or left.

Slowly the "Wiz" made his way back and directly under the hole in the concrete work. He listened carefully, but no sound broke the stillness of the evening save the purr of a motor car in the distance.

Mooring his canoe to a stick extending above the surface the "Wiz" stood upright and endeavored to reach the hole, but despite his height he was four inches short.

With a quick jump he caught the edge of the opening and drew himself up. His pocket searchlight showed a low chamber that is usually left in concrete bridges. The reinforcing of iron rods showed up under the bright spot of his lamp.

After listening again he carefully examined the floor and noted that it was smoother on the right, no doubt from constant walking over it. Following this faint trail he crawled carefully along; the floor began to slope down as he progressed over the arch. Soon he was able to stand upright and use his flashlight.

As he slowly swung it around the enclosure he made out benches, tables, electric lights, generator set and other appliances of a workshop.

He threaded his way to the switchboard, quickly examined it and shoved up a switch. Instantly the place was flooded with light and a stentorian voice commanded "Hands up!"

Spinning on his heel the "Wiz" beheld two ugly looking men leveling revolvers at him and he thought it advisable to comply with their peremptory demand. One of them strode to his side and ran experienced fingers through his clothes. "No rod," he reported, "where's the jewelry?" The other tossed over a pair of handcuffs, which were speedily clicked onto the Wizard's wrists, fastening his hands behind him.

The two men drew aside and considered the case in whispers, while the "Wiz" was thinking rapidly. They assuredly would put him out of the way, he thought. How simple to hold him under the water till unconscious, turn loose his overturned canoe and everything would be nicely explained. Even expert canoeists and swimmers drown.

With these thoughts the "Wiz" looked around for a way out. He had no gun and he was handcuffed; things looked bad indeed.

Suddenly a brilliant idea struck him. His back was still turned to the switchboard. He would pull the switch and make a dash—a lot of use with hands manacled—and he laughed at himself. *"But why not melt the chain off?"* was his next thought.

Measuring the distance carefully with his eye and allowing for the surprise, he looked over his shoulder at the switchboard. Yes the main switch was just hip high.

Quick as a wink he pressed the handcuffs against the blades. A splutter and flash as they touched the metal, and the cave was in darkness. A loud report of the heavy fuses blowing, mingled with the bellow of anger from the men and the roar of an automatic. The chain on the handcuffs had melted and parted before the fuses had gone—trust the "Wiz" to guess this little detail after seeing the arc furnace and knowing its current drawing capacity!

IN THE SEPTEMBER "E.E."

Scheduled for the September issue of The Electrical Experimenter among other timely articles are the following:

- *"Engineering as a Vocation." An article for students and parents. By H. Winfield Secor, Assoc. A.I.E.E.*
- *"Electrical Frauds—What They Are and How to Avoid Them."*
- *"Electricity the Mystic in Modern Hotels."*
- *"A Trip Through a Modern Electrical Research Laboratory." By Samuel Cohen.*
- *"Construction of a Home-made Static Machine." By Leonard R. Crow.*
- *"Experimental Chemistry Course"—Part IV. By Albert W. Wilsdon.*
- *"Marvels of Modern Physics." By Rogers D. Rusk, B.Sc.*
- *"Research as a National Duty." By Dr. Willis R. Whitney.*
- *"Making Selenium Cells." A How-to-make-it article.*
- *"Electric Motors—Some Things You Should Know About Them."*
- *"The Revolving Mirror for Determining Spark Characteristics."*

With wrists scorched from the hot metal the "Wiz" dove for the low chamber and freedom. Again the automatic spurted flame, but the "Wiz" was crawling for life. An age it seemed before he reached the hole and dropped through, upsetting the canoe in his fall.

Again in his element he threw all his strength into the racing crawl stroke, heading for the landing. Panting from his exertions he climbed at last onto the float. An instant later the rising moon shot flashes from a nickeled cylinder in his hand and the night was made hideous with the shriek of his police whistle.

Stumbling up the stairs, he almost ran into an officer with a gun in one hand and his club in the other. "The counterfeiters," blurted the "Wiz." "Call the reserves, I'll hold them," he snapped the order, snatched the officer's gun and ran down the steps again. To cower the law-breakers he sent two bullets roaring down the tunnel of the bridge.

All was silent for a few minutes and as the distant roar of a racing motor was heard two splashes under the bridge and a bullet plowed into the planking of the float.

The police auto pulled up with a rush and out scrambled the reserves with gleaming pistols and dangerous looking riot clubs.

As they ran down the steps the "Wiz" heard two splashes under the bridge and thought the men were trying to swim away.

"Guard the other side, some of you," snarled our hero, "or they will get away."

But no one appeared on the other side, so a council of war was held.

"Nothing to it," declared the captain of the reserves. "We'll have to go under and get them."

"What, into the face of their guns?" questioned the Wizard. "Not much; suffocate them with gas," he suggested.

A gun spat fire in the hands of one of the men guarding the bridge as he shouted, "They are swimming under water, look at those ripples," and he punctuated the remark with another shot.

A motion in the water and a head and shoulders appeared above the surface.

"Enough, we surrender," shouted the half drowned man and under the muzzles of a dozen revolvers they swam to shore and clambered up to the roadway.

Quite a crowd had collected meanwhile and the police had considerable trouble dispersing them.

"How can we ever repay you?" asked the captain, as the prisoners were safely in the van, and while he congratulated the "Wiz" on his nervy work.

"Oh, you've heard that about 'To the victor, etc.,' I'll be satisfied," replied the "Wiz."

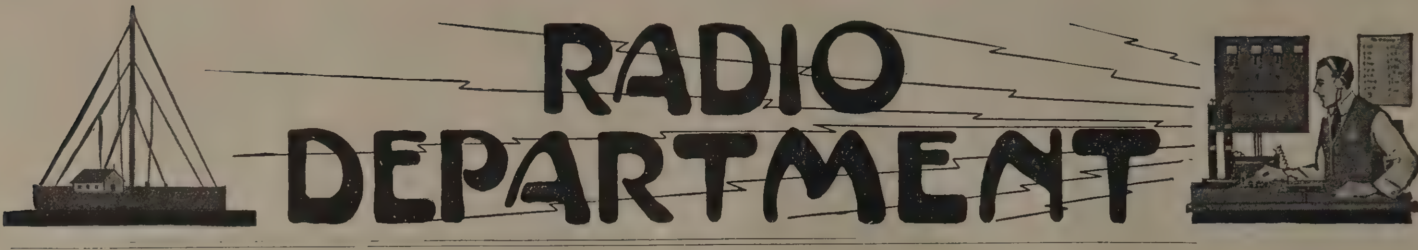
"Certainly, certainly," replied the captain, laughing, and bade the "Wiz" good-night, while the latter made his way homeward to dream of the real electric furnace, generator set and switchboard he would receive when the trial was over.

"I wonder," he drowsily remarked to the pillow, "if it pays to make money anyway!"

THE MICROPHONE IN SURGERY.

As an adjunct to the Army X-ray equipment, microphones are being used to locate metal imbedded in the flesh. In this apparatus one terminal of the receiver is connected to the surgeon's exploring instrument, or probe. The other terminal is connected to a carbon plate, moistened with salt water, which is applied to the patient's skin. When the probe comes in contact with a metal particle, there is a rattling, scraping sound in the receiver. The probe is also made in the form of forceps, by which metal particles can be extracted. Another device for the same work consists of an electromagnet, energized by alternating current. When the pole of the magnet is brought even near a bit of shell, the metal vibrates in synchronism with the alternating current. The point of maximum vibration is directly over the metal. At a lecture recently given at the Royal Institution, England, a piece of metal was imbedded in gelatine, and the vibrations were projected on a screen.

AMONG the hundreds of new devices and appliances published monthly in The Electrical Experimenter, there are several, as a rule, which interest you. Full information on these subjects, as well as the name of the manufacturer, will be gladly furnished to you, free of charge, by addressing our Technical Information Bureau.



The Vacuum Detector and How It Works

In endeavoring to make this article an authoritative one, the original manuscript was submitted to Dr. de Forest, Professor J. H. Morecroft, as well as Mr. E. H. Armstrong, who are unquestionably the highest living authorities on this most interesting device. The editors here desire to voice their appreciation to the three distinguished scientists.

IN the accompanying illustrations we have attempted to show in a graphical manner the general phenomena occurring in the vacuum radio detector of the Audion type, as developed and improved upon by de Forest, Langmuir, Logwood, Armstrong and others. Considering first the basic actions taking place within such a bulb, it may be said that when the lamp filament in the bulb is lighted there takes place a more or less powerful emission of electrons or negative charges of electricity. These electrons are shot off from the filament at low velocity and pass through the wire grid, impinging against the metal wing or plate, as is evident from the illustration.

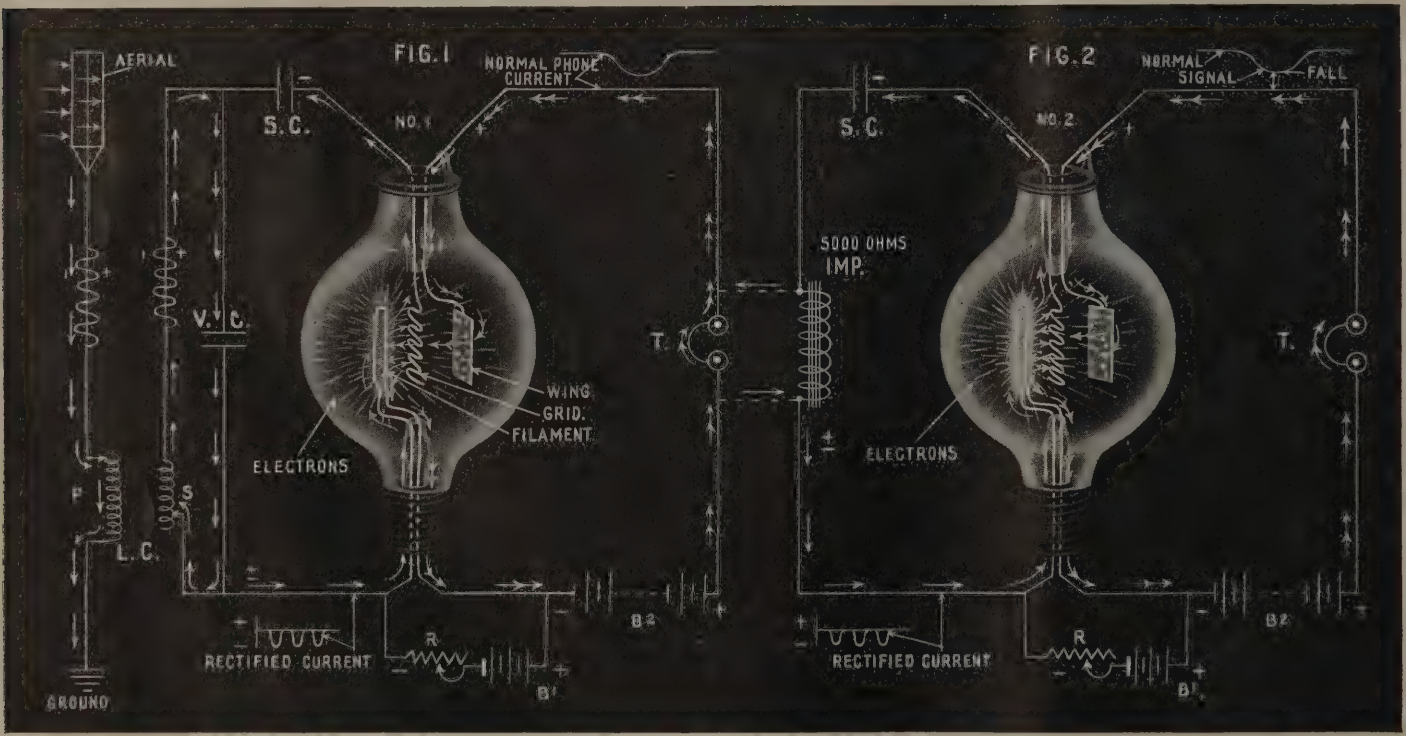
As pointed out many years ago, particularly in the works of Dr. J. A. Fleming, who first used the Edison lamp rectifier as a radio detector, there is manifested within the bulb, under working conditions, what is known as *unilateral conductivity*. This action concerns the transfer of negative electrical charges from the hot filament to the cold grid or wing. In other words, negative electricity will pass from the incandescent light filament to the wing or grid, *but not in the opposite direction.*

When the evacuated space between the filament and wing is surcharged by the passage of electrons through it, it becomes conductive to the current from the high voltage battery, B², which flows through the telephone receivers, T. When the filament is lighted, under normal conditions and with no radio signals coming in, there is a steady flow of current through the 'phones and along the wire connected to the wing within the bulb. This current is conducted across the space between the wing and the filament by the ionized state of the gas as aforementioned. This circuit completes itself through the filament feed wire and thence back to the negative pole of the battery, B².

To start with, suppose that an incoming signal in the form of an electromagnetic wave impinges upon the aerial; this, in turn, sets up high frequency oscillating (or alternating) currents in the antenna circuit, which includes the primary, P, of a loose coupler or transformer, LC. By magnetic induction this current is transferred (and usually changed in potential) to the secondary circuit, S, of the loose coupler. In the circuit at Fig. 1, which is a standard one, an oscillating current will flow around the circuit S-VC. Also this circuit may be tuned to resonance with respect to the incoming wave length. This current, when led off to the filament and grid of the vacuum valve, becomes rectified; that is, the negative pulses are permitted to pass from the hot filament to the cold grid. The grid, too, in virtue of its position in the electron stream, gathers up an appreciable negative charge; in other words, a negative charge is accumulated on it. This charge naturally passes along the wire connected to the right-hand plate of the stopping condenser SC. When this occurs there is a scattering effect in the electron field between the filament and wing, which weakens it, in so far as conductivity is concerned. Hence the current, passing from the positively charged wing to the filament, is reduced, as shown by the graphic curve in the upper right corner of Fig. 1. The time period of this depression in the wing current corresponds to that of a group of sparks, or in other words the *group frequency* of the transmitting station. In consequence the telephone receivers, T, will sound, or their diaphragms are partially released while this effect occurs. On the cessation of the incoming signal, the negative charge on the grid and in the condenser gradually dissipates and the circuits regain their normal state.

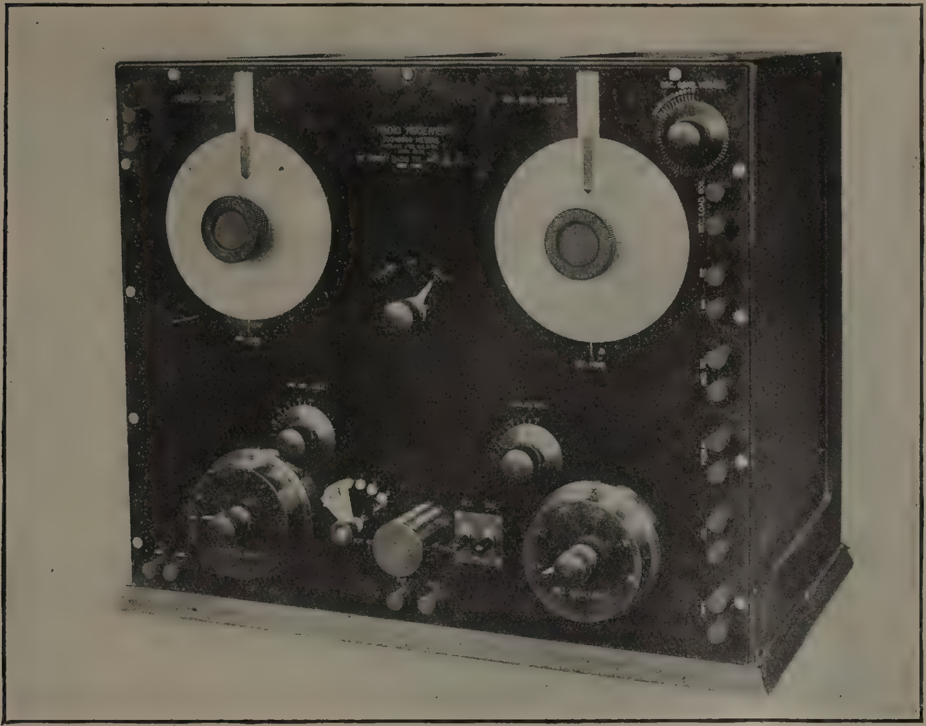
It has been found from careful tests conducted at the Radio Laboratory at Columbia University, New York City, in some worthy qualitative experiments made by Professor J. H. Morecroft and Mr. E. H. Armstrong, E.E., that if a *positive* potential is applied to the grid within the detector, that the current passing from the wing itself to the filament will be *increased;* also that with the application of a *negative* potential to the

(*Continued on page 288*)



Actions Taking Place in the Vacuum Detector (at Left) and Compound Action of Two Stage Amplifier Comprising Two Bulbs Connected in Cascade.

A UNIQUE CALIBRATED RADIO RECEIVING SET.



Latest De Forest Radio Receiving Set With Calibrated Inductance and Condenser Knobs Enabling The Wave Length of an Incoming Signal to Be Instantly Determined. Adapted to Damped and Undamped Waves.

A unique radio receiving outfit has recently been brought out by Dr. Lee De Forest, the inventor of the audion. The design combines the latest improvements in receiving sets. The cabinet was so designed that the wave length of the receiving station is directly read on two special scales at front of the panel. The primary inductance coils, within the cabinet, are controlled by means of a circular switch contained in a small chamber at the left-hand lower corner of the cabinet. The switch handle is directly connected to a pointer reading on the circular scale of the primary condenser at the upper left-hand corner. By turning the primary coil switch the pointer is moved up or down as the inductance is changed. The switch case is marked with eight letters, which correspond to the eight semi-circular lines on the primary condenser dial, which are also marked with the same letters. The bottom of the dial is graduated into 180 degrees for condenser readings. The secondary circuit is composed of the same arrangement. The pointers of the condensers of both primary and secondary circuits are actuated by special gears which are carefully inclosed in the cabinet. Variation in coupling between the primary and secondary coils is accomplished by turning a rubber knob at the right and above the primary switch. The numerals stamped in the panel show the percentage of coupling.

This outfit was designed so that both a crystal and audion detector could be used, also so that the audion detector can be made to oscillate to receive undamped wave signals. A double jack switch is provided to connect a crystal detector and another switch is used for the buzzer test. This buzzer gives a high frequency note. A stopping condenser is provided for the telephone circuit. It consists of three sections, controlled by means of the claw switch at the left of the buzzer.

The degree of the oscillations produced by the audion detector when it is in a regenerating condition is controlled by means of a coupling coil called the "tickler," regulated by a circular knob at the left and above the secondary switch. This tickler coil is connected across the grid and filament of the audion detector. With this arrangement the oscillating point of the detector is quickly obtained and considerable time is saved when the operator wishes to change quickly from receiving sustained wave stations to spark sets.

A very important piece of apparatus in this outfit is the secondary condenser *vernier*, located at the extreme right-hand corner of the cabinet. This consists of a small condenser shunted across the secondary coil of the receiving transformer, and by slightly varying the capacity the receiving station is thus accurately tuned, and by noting the position of both the stationary and movable marks the exact wave length of the received wave is determined. It can be tuned to read the wave length to one meter accuracy, which is difficult even with a modern precision wave meter. Another interesting and yet important piece of apparatus is a switch which connects the various instruments in such a manner as to either make it a *standby* set or otherwise, and this switch is seen between the two condenser dials. It is so connected that it can add more inductance than capacity, and if such a condition is desired the switch is turned to the left; if it is necessary to receive sharply tuned waves it is turned to the right. The various binding posts placed in front of the cabinet are used to connect up the different instruments which are required for operating this set.

The tuning is performed in the same manner as with a standard set, with the exception of the additional apparatus. The wave length of the received signal is determined by noting the positions of the scales of all the calibrated instruments, when the received wave is most accurately tuned; these positions are referred to certain values on a special curve, which shows the exact wave lengths at every position of the scales.

It is necessary, of course, to employ an antenna of given size as the whole system of the set is calibrated with the antenna in circuit.

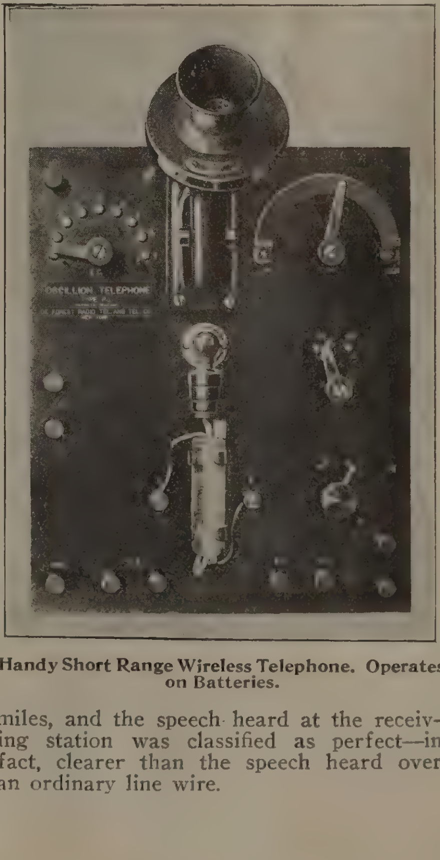
NEW RADIO TELEPHONE TRANSMITTER.

A very simple and efficient radio telephonic transmitter has been developed by Dr. Lee de Forest. Here, again, the Audion is used, this time as a high frequency generator for radio telephony.

This simplified set consists of an *Oscillion* tube, which is a special audion tube, highly evacuated. The grid and wing circuits of this generator are connected with an inductance and capacity to cause the tube to oscillate or produce a radio frequency, undamped oscillatory current for the antenna circuit. The wing circuit is connected to 250 volts direct current, obtained either from flash-light batteries or electric power mains. The former is more suitable, as the current is stable and direct, while the latter is somewhat pulsatory. The amount of current used by the so-called regenerating current is so infinitesimal that it is unnoticeable; it amounts only to about 20 milliamperes. This high voltage current is regulated by means of a semi-circular graphite resistor, located at the upper right hand corner of the panel. The current for lighting the filament is furnished by a six volt battery while the brilliancy of the filament is regulated by the rheostat, at the lower right hand corner of the panel. The wave length of the transmitter is controlled by a variable antenna inductance coil connected with the aerial. The inductance is changed by a nine point switch at the extreme left hand side.

The telephonic speech is controlled by a specially designed transmitter suited for this purpose, and which is supported on a movable arm as the illustration shows. It is supplied with battery power, which operates a coil linked to the oscillating circuit, thus controlling the amount of current sent through the antenna.

This outfit has covered a distance of five miles, and the speech heard at the receiving station was classified as perfect—in fact, clearer than the speech heard over an ordinary line wire.



Handy Short Range Wireless Telephone. Operates on Batteries.

Modern Radio Receiving Apparatus

By Samuel Cohen

IN the last issue of THE ELECTRICAL EXPERIMENTER various new radio transmitting apparatus were discussed; in this number we will confine ourselves to modern receiving instruments.

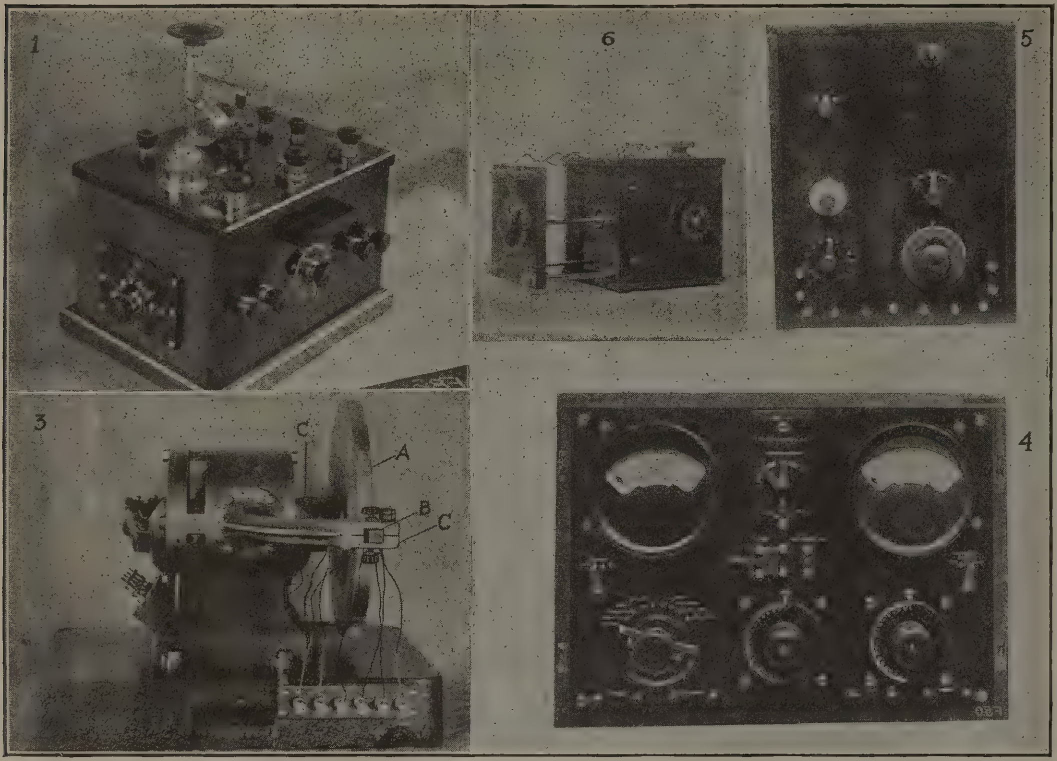


Fig. 1. New Crystal Detector; Fig. 3. Radio Frequency Alternator for "Beat" Receiver; Fig. 4. Calibrated Control Panel for Arc Used with Heterodyne; Fig. 5. Oscillating Audion Panel for Undamped Wave Reception and Fig. 6. Improved Loose Coupler with Pancake Windings.

Fig. 1 shows a detector cabinet consisting of a Fessenden liquid barretter (electrolytic detector). The adjustment of the platinum wire used with this type of detector is obtained by turning the large horizontal knob supported on the bracket. The acid is kept in a non-corrosive receptacle. A special crystal detector is also used, which employs a new crystal called "Ronescon." The composition of this crystal is still kept secret due to patents which have been applied for. This detector is enclosed in a metallic case and once adjusted to its maximum sensitivity it is extremely stable. Moreover, it is not affected by near-by transmitting stations; the detector case may be clearly seen on the left of the cover. A switch is provided for throwing in either the Ronescon or liquid barretter. In using the electrolytic detector a potentiometer and battery are necessary. The regulation of resistance is obtained by turning a rotary knob on the front side of the case. A protective gap and buzzer test switch are also mounted on top of the cabinet, while the various binding posts are used to connect the detector to the tuning instruments.

The first detector, if such it may be called, used for receiving undamped wave stations, was the *tikker*, perfected by Valdemar Poulsen. This savant employed two gold wires touching very lightly, one of which was caused to vibrate by an electromagnet, excited by alternating current. Another type of instrument employed is an electrical interrupter, causing one of the gold wires to vibrate at high speed. Such a tikker is shown in Fig. 2. The two gold wires, P_1 P_2, are supported by two standards as the reader may perceive. The vibrating one is connected to arm V, which is linked to the armature of a special buzzer contained in the box. The stationary electrode, P_2, is held on an angle standard H, regulated by thumb screw S. When adjustments between the wires P_1 and P_2 are required, the thumb-screw S is regulated until the proper contact between the wires is obtained. The current for the interrupter is fed through binding posts, K_1 K_1, while terminals, KK, are used for connecting to the contacts.

In receiving sustained wave signals, it is necessary to excite the receiver from an external source of power, of such a frequency as to produce an interfering wave or "beat." This method of reception was originated by Fessenden, who at first employed a high frequency alternator to excite a standard receiving outfit. The alternator used for this purpose is illustrated in Fig. 3. It is of the inductor type, consisting of a steel disk, A, with a large number of teeth on its periphery, similar to a gear wheel. This disk is rapidly revolved by a high speed electric motor. The high frequency current is obtained from two sets of electro-magnets, BB, placed perpendicularly to the circumferential face of the rotor. These electro-magnets contain two sets of windings, one of which is used for magnetizing the iron core by a direct current passed through it, while in the secondary winding the sustained wave current is induced by the movement of the rotor. The magnets are supported by substantially built brackets, CC. This generator develops 120,000 cycles at 6,000 R.P.M. The complete unit is substantially mounted on a heavy base, to withstand the vibration of the motor and rotor.

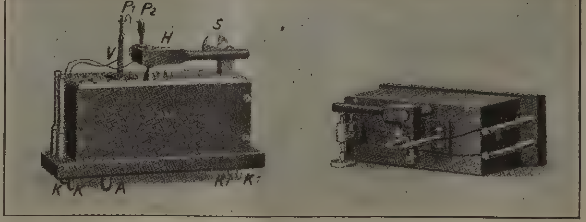


Fig. 2. Vibrating "Tikker" for Undamped Wave Reception. Employs Two Gold Wires for Interrupting 'Phone Circuit.

While the high frequency alternator is still used for exciting the regular receiver circuit, it was found that the oscillating arc was also suitable for this particular work. Fig. 4 illustrates a panel for controlling such an arc. The meter toward the left indicates the voltage in the arc circuit, while the one at the right indicates the current in amperes consumed by the arc. The switch between the meters controls the capacity of the condenser, while the pointer beneath shows the wave lengths at the various points. When a certain wave length is required, it is only necessary to place the condenser pointer at the required value and to set the inductance at the proper point. The coil which regulates the oscillating circuit is located at the lower left end of the case. Each one of the contacts is marked with two wave length readings. In order to obtain a wave which is located between any one of the readings, it is necessary to adjust the condenser switch just described, and carefully adjust another variable condenser at the right of the inductance coil. If the required wave length cannot be obtained, it is then necessary to use the larger condenser. This is shown on the lower right hand corner. The double throw switch located below the condenser switch is used for connecting the ammeter in the direct current arc supply circuit, or else in the oscillating circuit; thus indicating the amount of high frequency current that the generator is delivering to the receiving instrument. The arc generator, which is not shown, consists of a metallic chamber, containing a copper and carbon electrode, the former being water cooled. The outside chamber supports an oil cup containing alcohol and it is allowed to drip between the electrodes of the arc, thus vaporizing and producing a gas in the arc chamber. The current for the arc is supplied by a 500-volt direct current generator.

Our readers are aware, undoubtedly, that the audion detector can also be used as a high frequency generator for "beat" excitation purposes, providing it is connected with suitable inductance and capacity. The apparatus illustrated at Fig. 5 is an audion oscillating current exciter of the type employed for commercial work. It consists of a standard type bulb enclosed in the cabinet. The inductance is also contained in the box and is controlled by a fifteen point switch mounted at the lower left hand corner. The capacity consists of an air dielectric condenser, located at the lower right hand side of the case. The high voltage current of the grid circuit is regu-

(*Continued on page 288*)

TRANSMISSION OF WEATHER REPORTS.

By Arlington, Va. (Call N A A).

All bulletins begin with the letters U.S. W.B. (United States Weather Bureau), and the weather conditions follow. The first three figures of a report represent the barometric pressure in inches (002=30.02); the next figure, the fourth in sequence, represents the direction of the wind to the eight points of the compass: 1=north, 2=northeast, 3=east, 4=southeast, 5=south, 6=southwest, 7=west, 8=northwest, and 0=calm. The fifth figure represents the force of the wind on the Beaufort Scale, given below.

Beaufort Scale of Wind Force.

Number and Designation.	Statute miles per hour.	Nautical miles per hour.
0. Calm	0 to 3	0 to 2.6
1. Light air	8	6.9
2. Light breeze	13	11.3
3. Gentle breeze	18	15.6
4. Moderate breeze	23	20.0
5. Fresh breeze	28	24.3
6. Strong breeze	34	29.5
7. Moderate gale	40	34.7
8. Fresh gale	48	41.6
9. Strong gale	56	48.6
10. Whole gale	65	56.4
11. Storm	75	65.1
12. Hurricane	90 and over	78.1 and over

In order to simplify the code, no provision has been made for wind force greater than 9, strong gale, on the Beaufort Scale. Whenever winds of greater force than 9 occur the number representing them is given in words instead of figures, thus: Ten, eleven, etc.

The points for which weather reports are furnished are designated as follows:

For Atlantic coast and Gulf points—

S=Sydney.
P=Pensacola.
C=Charleston.
DB=Delaware Breakwater.
H=Hatteras.
T=Nantucket.
B=Bermuda.
K=Key West.

For points on the Great Lakes—

DU=Duluth.
D=Detroit.
Ch=Chicago.
U=Sault Ste. Marie.
G=Green Bay.
M=Marquette.
V=Cleveland.
L=Alpena.
F=Buffalo.

EXAMPLE OF CODE.

U.S.W.B.—S 96465, T 91674, DB 94686, H 99886, C 01214, K 02622, P 03613, B 00065.

Translation.

United States Weather Bureau.

Station.	Pressure.	Wind.	
		Direction.	Force.*
Sydney	29.64	SW	5
Nantucket	29.16	W	4
Delaware Breakwater	29.46	NW	6
Hatteras	29.98	NW	6
Charleston	30.12	N	4
Key West	30.26	NE	2
Pensacola	30.36	N	3
Bermuda	30.00	SW	5

*See Beaufort Scale.

After the report for the Atlantic Coast and Gulf of Mexico, comes the Great Lakes report.

U.S.W.B.—DU 95826, M 97635, U 00443, G 96046, Ch 95667, L 00644, D 00842, V 01054, F 01656.

Station.	Pressure.	Wind.	
		Direction.	Force.*
Duluth	29.58	NE	6
Marquette	29.76	E	5
Sault Ste. Marie	30.04	SE	3
Green Bay	29.60	SE	6
Chicago	29.56	SW	7
Alpena	30.06	SE	4
Detroit	30.08	SE	2
Cleveland	30.10	S	4
Buffalo	30.16	S	6

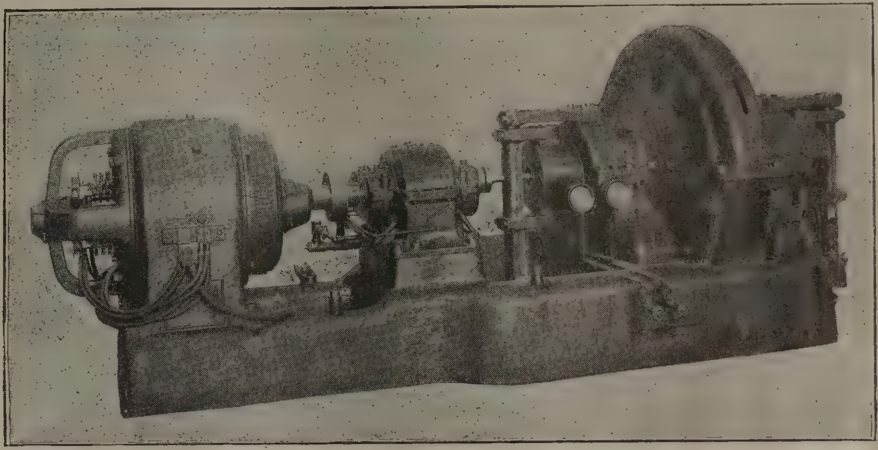
*See Beaufort Scale.

A 100 K.W. Radio Frequency Alternator.

The photograph with this article is of one of the most remarkable alternators ever built. It was developed in the research laboratory of the General Electric Company. At a speed of 3,600 revolutions per minute, it has yielded an output of 100 k.w. with a frequency of 50,000 cycles per second. The voltage developed is rather low, but this may be changed to suit any requirements by means of a variable ratio transformer used with the machine. This remarkable electrodynamic mechanism represents one of the first of the really large machines of its type which will be used more extensively for high frequency work in the future. It has been proven in practice—notably at radio station at Tuckerton, N.J.—where the Goldschmidt radio frequency alternator has been used, that this type of alternator is the most efficient for work under all conditions. They are constant in their output, and now means have been perfected whereby they can be very easily controlled by the human voice for radiotelephonic purposes. It will possibly result in the design of similar alternators capable of delivering high frequency alternating current, with an output of several hundred kilowatts.

Great credit is due to Mr. Alexanderson, of the General Electric Company's research staff, who has spent much time and study on the perfection of designs for these radio-frequency alternating current generators with a large output, since it has only been in the past few years that such machines have been operated successfully. There were a number of these high-frequency alternators built several years ago by Dr. Fessenden, delivering as high as 200,000 cycles per second, but the output was generally limited to a few kilowatts.

By means of the wonderful vacuum trigger tubes, also developed by the company building these new high power alternators, the output can be exactly and perfectly controlled.



Latest Radio Frequency Alternator. Electrically Driven at a Speed of 3600 R. P. M., It Produces 100 Kilowatts at a Frequency of 50,000 Cycles Per Second. It is of the G. E.-Alexanderson Type.

REMARKABLE RANGES COVERED BY RADIO.

In the current number of the Proceedings of the Institute of Radio Engineers Leonard F. Fuller, chief engineer for the Federal Telegraph Company, cites some remarkable long distance radio work accomplished with undamped waves.

On September 1, 1915, the steamer *Ventura* of the Oceanic Steamship Company left San Francisco for Sydney, Australia. Installed on the ship was a 5 K.W. Federal-Poulsen arc set. At San Francisco a 30 K.W. set was used. The antenna current was 50 to 60 amperes and the wave length 8,000 meters. The following reception was accomplished on the *Ventura.*

A distance of 3,830 miles (6,150 km) from San Francisco, the signals could be copied on the typewriter, in September, 1915, by daylight. At a distance of 4,200 miles (6,750 km) the messages could be copied by pencil in daylight through heavy strays (static). At a distance of 5,140 miles (8,260 km) the messages could be copied by pencil in daylight through light strays.

During the month of September, 1915, the ship being on a course between Hawaii and Samoa, the signals from Tuckerton, N.J., were copied on the typewriter in the early evening. The *Ventura* was then 3,840 miles (6,180 km) from San Francisco.

Evening signals in September, 1915, from Tuckerton were copied by pencil on the *Ventura* when 530 miles (850 km) southwest of Samoa, 5,320 miles (8,550 km) from San Francisco, and approximately 8,000 miles (13,000 km) from Tuckerton. This reception from Tuckerton was often duplicated. Tuckerton used a 60 K.W. arc set and an antenna current of 100 to 120 amperes. The signals from the Tuckerton (Goldschmidt radio frequency) alternator were also received when 3,840 miles (6,180 km) from San Francisco.

In May, 1915, the steamship *Sierra*, 1,700 miles (2,600 km) west of San Francisco, copied messages from Nauen, Germany, by pencil, the total distance being approximately 8,600 miles (14,000 km).

In December, 1914, the South San Francisco station copied by pencil in daylight the Nauen signals at a distance of approximately 7,000 miles (11,000 km).

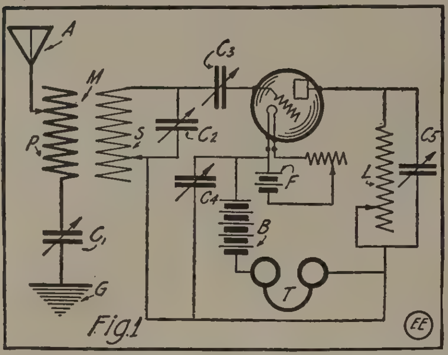
Eilvese, Germany, has also been heard 1,700 miles (2,700 km) west of San Francisco on board ship and at night at the Honolulu station of the Federal Telegraph Company.

Long Distance Receiving With the Audion Heterodyne

Details of Audion Receiving Circuits with Which German Stations Have Been Heard at St. Louis, Mo., as Well as All the Large American Stations.

By A. S. Blatterman, B. Sc.*

THE comparatively recent development of the audion detector into the singing—relay form of radio-frequency oscillation generator has given a great impetus to the heterodyne or electrical beat method of receiving in wireless telegraphy, since it has provided a cheap and highly satisfactory generator for such purposes.



One Method of Hooking Up an Ordinary Audion so as to Produce "Beats" for Undamped Wave Reception.

It is the aim of this paper to describe the apparatus and the very gratifying results obtained therewith at Washington University during the last three months, in which the beat principle has been employed in receiving signals from very distant stations using sustained wave transmitters.

A wireless telegraphic receiver embodies two distinct parts, the tuning apparatus and the detector. The former consists of tuning inductance coils and adjustable condensers. The detector may take any one of several forms. In former years the coherer was used; later came the electrolytic detector, the magnetic and crystalline types, and finally the audion. Since the very beginning of the art there has beeen a marked tendency toward the development of detectors of high sensitivity, and this is not at all surprising when one stops to consider that it is really the detector which limits wireless ranges. Sensitive detectors respond to weaker signals and at a greater distance from a transmitter of given power.

For a number of years the audion has been limited to the comparatively simple service of acting as a super-sensitive detector; it simply replaced, on account of its greater sensitiveness, the old coherer and other detectors. The actions occurring within the device were imperfectly understood. Recently, however, experiments have thrown more light on the operating characteristics of the audion and it has been found that the same bulb will perform the functions of *detector*, *amplifier*, and *generator*. This carries with it some very important practical advantages.

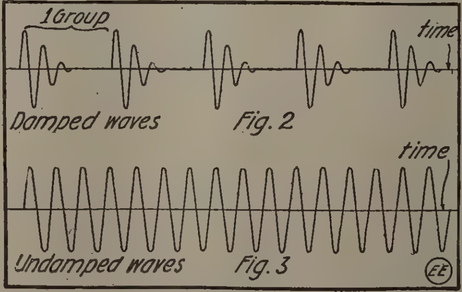
A large number of high-power radio stations now use transmitters of the arc and radio-frequency alternator types. These transmitters produce *sustained* or *undamped* waves, and cannot be received on ordinary detectors or on the audion either, when used as a simple detector. The more common transmitters such as those found on ship-board and the majority of land stations which employ a spark at the sending instrument, produce *damped* waves; these are readily detected by any of the common detectors. For receiving the *undamped* waves special apparatus must be used.

The apparatus recently installed at Washington University for this purpose consists of a large loose coupler having its primary and secondary wound with No. 32 B. & S. magnet wire and so arranged that the mutual inductance between the two coils may be made very small. This has been found to be highly essential in the reception of *sustained* or *undamped* waves. The loose coupler is shown at M in Fig. 1. It is capable of tuning to wave lengths up to 15,000 meters. It is to be noted that all of the sustained wave stations use very long waves as compared with the usual spark stations.

Referring again to Fig. 1, A is the aerial and G is the connection to earth. C_1 is a variable condenser of 0.004 mf. maximum capacity which is used for fine adjustments in tuning the aerial circuit. C_2 and C_3 are variable condensers of small capacity, 0.0008 mf. maximum. The condenser C_4 has a maximum capacity of 0.004 mf. though it is frequently possible to dispense with this condenser altogether. Its purpose is to offer a path of low impedance for the radio-frequency currents past the telephones and battery B, and very often, especially when receiving short, wave stations, i. e., 2,000 or 3,000 meters, the capacity of the telephone cords themselves is sufficient to by-pass the radio-frequency current. The battery B consists of flash-light dry cells giving a total of about 35 volts. F is a 4 to 6 volt storage battery for lighting the filament of the audion.

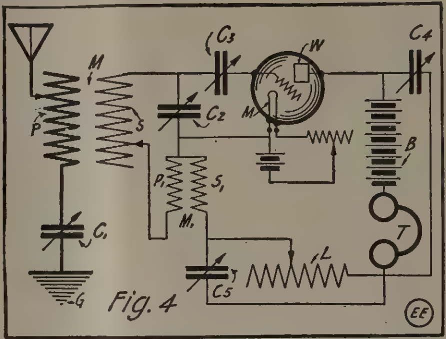
The problem encountered in receiving sustained waves may be best understood by considering first the difference between the *damped* oscillations emitted by spark transmitters and the *undamped* oscillations produced by the newest high power arc and high-frequency machine transmitters.

Fig. 2 shows oscillations of the first type. Each spark at the transmitter produces an oscillation which is damped out after 20 or 30 alternations or so. *A considerable interval then elapses until another spark occurs.* With the new spark there comes another train of damped oscillations, etc. Thus, energy is radiated from the sending aerial in gushes, so to speak, separated by intervals of inactivity. There may be several hundred or a thousand groups of oscillations in a second; which follow each other at regular intervals corresponding to the interval between sparks. At a receiving station each group of oscillations produces a click in the telephone receivers. Thus the signals received from spark transmitters have a certain characteristic tone produced by the several hundred or more clicks per second in the telephone receivers. For example, a transmitter with a spark frequency of 256 produces at the receiving station a note or tone corresponding to the middle C on the piano.



How Damped Waves Differ From Undamped Waves as Used in Radio-Telegraphic Transmission

Consider now the energy radiated by transmitters of the second type, that is, sustained wave transmitters, using direct current arcs or machines. Fig. 3 shows a train of *undamped* oscillations. The frequency of these oscillations may be the same as that of the oscillations from the spark transmitter, but in this case the stream of energy is unbroken; there are no periods of inactivity—no *groups* of oscillations.



A Second Method of Arranging an Audion Detector to Interpret Continuous Wave Signals.

Now the frequency of the oscillations from either arc or spark is of the order of 30,000 to 100,000 per second, too high to be heard individually, since the ear is only sensitive to oscillations somewhat under 30,000. Hence, the individual oscillations are never heard in any case. With spark transmitters it is the *cumulative* effect of each group or train of oscillations which produces the audible click and these groups recur at audible frequency, i. e., about 1,000 more or ess, giving a rather musical note. It is obvious, however, in the case of sustained wave transmitters, that since the frequency is so high and there are no groups or trains of oscillations that no sound can be heard when using the ordinary receiver as for spark reception.

One way in which the received energy can be made to produce audible signals is to insert a vibrating contact into the receiving circuit so as to open and then close the circuit at an audible rate. In this way the received train of undamped high-frequency energy is broken up into groups each of which produces a click in the telephone similar to the case of spark reception. This is known as the *tikker* method of reception. It has been used at this station, but does not show a sensitivity on spark stations greatly exceeding that of the ordinary detectors.

A far better way of receiving sustained waves is that now in use and which involves the *heterodyne* or *beat* principle. The general idea involved is to introduce into the receiving circuits a *second* or superimposed, sustained, oscillating current of radio-frequency. This may, for example, be obtained from a sustained wave, high-frequency generator, such as the direct current arc, at the receiving station. If then the frequency of this local oscillation is made slightly different from the oscillation arriving on the antenna, the two will interact, and produce a *beat frequency* which may be made quite low—well within the audible limits. The beat frequency is the difference between the two interacting frequencies.

It has beeen found possible to use the regular audion detector for the production of the local sustained oscillation; and in addition to its use in these ways, the same bulb can be used to *amplify* the signals. There are various ways of arranging the audion in the receptor circuits to accomplish these results. That shown in Fig. 1 has been found very suitable, especially from the standpoint of simplicity.

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*Instructor in Electrical Engineering, Washington University, St. Louis, Mo.

The capacity C_4 is required to make the audion generate and is generally larger for long than for short waves, that is, for low compared to high frequencies. For short waves the capacity of the telephone cords themselves is often sufficient. This has been found to be the case when receiving sustained waves from Arlington on 5,000 meters, New Orleans, N A T, on 6,000 meters, Key West, N A R, Boston, N A D, University of North Dakota and 9 X N on 2,500 meters. The use of the condenser is very beneficial in receiving Arlington's long wave at 7,000 meters as well as Darien, Panama, sending on 10,000 meters. Of the above stations, Darien is the most distant, being 2,500 miles from St. Louis.

The amplification feature is obtained by the use of the inductance L, and the capacity C_5. The telephone circuit is tuned by these and an amplification of 4 or 5 times (measured) is secured on waves of 6,000 meters. The amplification is not so pronounced on longer waves, in the neighborhood of 10,000 meters.

In operation the circuits S, C_2, C_3, L, C_5 are adjusted to oscillate at a frequency slightly different from that arriving on the antenna. For instance, when receiving from Darien, whose wave length is 10,000 meters, the local oscillation may be set at 29,000 per second. 10,000 meters corresponds to the frequency 30,000. Thus, the local 29,000 cycles react with the received energy at 30,000 cycles and produce an audible *beat frequency* equal to the difference between 30,000 and 29,000 or 1,000 cycles.

It must be noted that neither the local oscillation of the audion at 29,000 cycles nor the received energy at 30,000 cycles is audible, when acting alone in the circuit, since they are both well above the limit of audibility and certainly beyond the possibility of the ordinary telephone receiver.

By changing the frequency of the local oscillations, by adjusting the capacity or inductance at some point in the circuit, the beat frequency, and thus the tone of the received signal, can be varied over a wide range.

The apparatus is very sensitive in this respect. *Movements of the operator's hand in the vicinity of the circuits alter the capacity of the system sufficiently to cause quite large fluctuations in tone.* The signals come in on this receiver in the form of very pure musical notes resembling those of a flute or a clear whistle. They are not at all like the signals from the ordinary spark stations.

Another circuit which has given exceedingly satisfactory results, although it requires greater care and delicacy in handling, is that shown in Fig. 4. Here, the various elements are the same as those of Fig. 1, with the exception that a second air-core transformer or loose-coupler M_1, having variable coupling, is introduced as indicated. This circuit operates as follows:

Oscillations arriving on the antenna induce others in the secondary of the main loose-coupler M, whence they are led to the grid of the audion through C_3. Normally a steady current flows in the wing circuit $WBTLS_1M$ under the the pressure of the battery B; but when the potential on the grid alternates, the conductivity of the vacuum space within the audion is changed, so that there is superposed on this steady current an alternating current of the same frequency as that applied to the grid. The alternating currents of the grid circuit are thus repeated into the wing circuit. There they find an easy path through the condenser C_4, and the circuit is tuned by L and C_5, so that the response is augmented. The current is then led through the coil S_1 of the coupler M_1, and back to the filament

(*Continued on page 289*)

SENDING ON A SHORT WAVE.

By R. H. Soster.

As every wireless amateur having a licensed station knows, the Government regulations require that the wave length transmitted be 200 meters or under, and furthermore that it be "sharp." Reducing the natural period of the aerial to 200 meters or less is an easy matter, but to adjust the transmitting wave length so that it will not exceed 200 meters and also that it be a sharply tuned wave, is no easy matter. In the following article I will relate the experience I gained while adjusting and tuning two private radio stations, and by taking advantage of this experience the average amateur ought to have little, if any, trouble in making his station comply with the law.

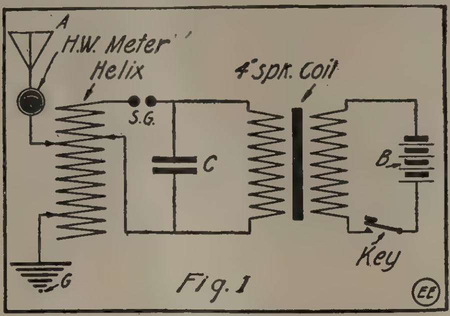


Fig. 1

Hook-Up for Spark Coil Radio Transmitter Excited by Battery

The stations above mentioned were located about six miles apart and both were within five miles of a large commercial station. I will call these stations A and B and consider them separately as the adjustment of each was considerably different.

Station A.

The transmitting equipment of Station A, consisted of a 4" spark coil run on storage batteries and consuming about 25 to 30 watts of current; high tension condenser in three units, having a capacity of .0017 M.F. per unit or .005 M.F. for the total condenser; unquenched or stationary spark gap; ordinary helix (close coupler), and hot-wire ammeter.

The instruments were connected up as shown in circuit No. 1, the primary and secondary connections on the helix being adjusted until the ammeter registered a maximum, which was .5 amperes; this being our radiation current. The aerial was 100 feet long with a lead-in wire 50 feet in length.

The first week the station was operated on this adjustment it was reported for working on a wave length of 650 meters. Amateurs will no doubt wonder how this was possible with an aerial of that size.

The natural period of the aerial was about 150 meters but as the wave transmitted was very broad it had the same effect as a longer wave and seriously interfered with other stations working on a 650 meter wave.

The first step I took was to reduce the aerial from 100 feet to 50 feet in length with a lead-in of 25 feet. The adjustments on the helix naturally had to be changed and when again properly adjusted the ammeter registered .4 amperes. With an aerial as small as this I failed to see how it could still interfere, even if the wave was broad, but very shortly we were informed that we were working on 350 meters and to "cut down."

I began to realize, then, that the trouble was inside, not outside, the station, but from force of habit, no doubt, I further reduced the aerial to 35 feet in length. I then turned my attention to the transmitting circuit.

It was very evident that the primary or oscillation circuit and secondary or aerial circuits, were not balanced. The decrement of the oscillation circuit was far in excess of the aerial circuit. Changing the turns on the helix merely cut down the radiation so I finally cut down the condenser. I reduced this to one unit instead of three, the capacity then being .0017 M.F. instead of .005 M.F. as before. The helix was then readjusted and the ammeter showed a radiation current of .3 amperes. We were later informed that we were working on a sharp 150 meter wave, and everything was satisfactory. This station, in spite of the small aerial, which was about 25 feet high at the highest point, had a transmitting range of 25 miles, and a receiving range of 350 miles, or better.

Station B.

Station B had a transmitting set consisting of a one-quarter K. W. closed core transformer having a secondary discharge of 6,000 volts and operated by 110 V. A. C., at 60 cycles; high tension condenser, the same as used at Station A; helix also the same; rotary spark gap and a hot-wire ammeter. The aerial was 150 feet long with a lead-in wire 75 feet long. The current radiated, as shown by the ammeter was 1 ampere. The station was reported for working on a 750 meter wave. As usual, I cut down the aerial to 50 feet long, and after readjusting the helix, the radiation current was .6 amperes. We were then notified that we were still working on over 500 meters. The aerial was further cut down to 35 feet in length and one section of condenser was removed. Two sections removed, "killed" the transformer, so we had to keep the two units in circuit. The radiation current was then .4 ampere and the station was notified it was working on 350 meters.

The trouble was simply a "broad wave," and every manner of adjustment or connection failed to remedy it. The amount of current in the primary circuit was so far in excess of the secondary circuit that it was impossible to add enough turns in the secondary circuit to counteract it and balance. The only remedy, therefore, was a loose coupler, and one was immediately installed. When connected up and adjusted it was found necessary to use very loose coupling to make the wave form sufficiently sharp. The connections used are shown in circuit No. 2. The radiation current was then .8 amperes and the station was working on a sharp wave, slightly under 200 meters in length.

A Few Don'ts.

Don't try to tune without a hot-wire ammeter. It is practically impossible to do so and the results will not be satisfactory.

Don't use a helix except with small power; a loose coupled transformer or oscillation transformer is much more efficient.

Don't use a long aerial. If the masts are high a short aerial is just as efficient. Use two aerials if necessary; one for sending, one for receiving (Gernsback Duplex Aerial System).

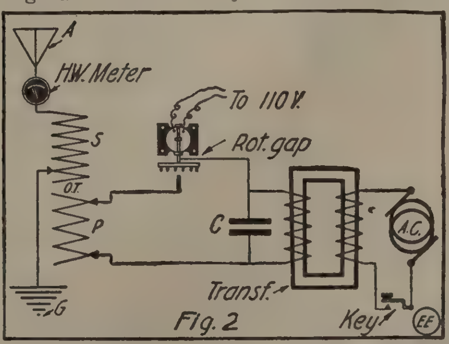


Fig. 2

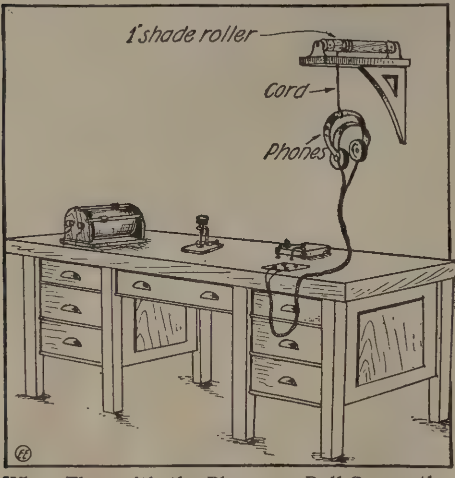
Proper Connections for A.C. Transformer Radio Sender, with Rotary Gap and Oscillation Transformer.

Don't rely entirely on your ammeter readings. It will not tell you whether your wave is sharp or broad.

ATTACHMENT FOR RAISING AND LOWERING HEAD-BAND.

The materials necessary for the construction of this device are a 1-inch window-shade roller, two shade roller brackets, one shelf bracket and a piece of wood 1 inch by 2 inches by 2 feet, and a piece of fishing line.

The shade roller is cut off from the solid end as short as possible and is fastened to the board by means of the two brackets. The shelf is then made up from the board and bracket and fastened to the wall. A ¼-inch hole is drilled in the center of the board about 3 inches from the end of the roller bracket. The shelf is fastened to the bracket and attached to the wall over the instrument table. The cord is secured to the roller and the headband. The headset can then be raised and lowered in the same way as a window shade.

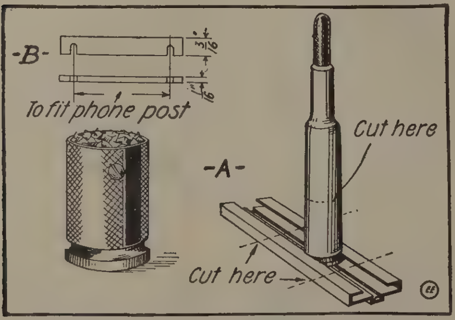


When Thru with the Phones, a Pull Causes the Shade Roller to Haul Them Up.

Contributed by E. L. KENNEY.

ROTARY DETECTOR CUP.

The accompanying drawing shows a rotary detector cup made from a cartridge shell and clip. A fully explains itself. B is a strip of brass cut as illustrated, and is used to test receivers when two are used with a head band. If slipped over the terminals of one receiver it short-circuits it and only the other receiver is heard; it may then be slipped off and put on the other receiver. Thus you can tell if the receivers are of similar tone. When used with a buzzer it is very handy.

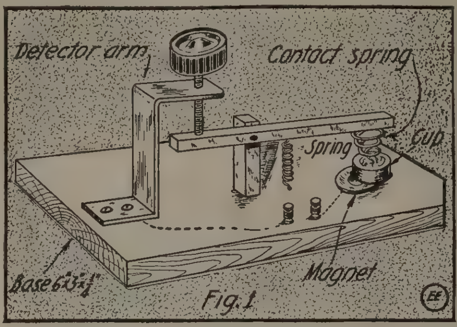


Revolvable and Removable Detector Cup Made from Cartridge Shell.

Contributed by JAMES HONEYCUTT.

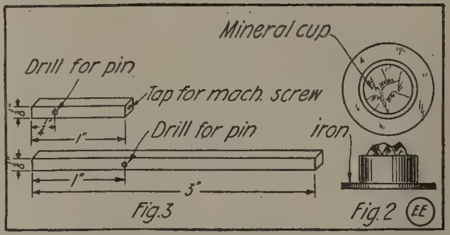
AN EASILY ADJUSTED DETECTOR.

The description which follows is of a detector which is very easy to adjust. The base is made of either hardwood or fiber, although fiber is best. It is 6x3x¼ inches, (See Fig. 1). Next take an upright arm and thumbscrew from an old detector. Fasten this at one end of the base about 1 inch from the end of same. Next procure two pieces of ⅛-inch square brass rod, Fig. 3. One piece is 3 inches long and the other, 1 inch long. In the shorter one, bore a small hole ¼ inch from one end. In the other end bore a hole and tap it to fit a machine screw. In the longer one bore a small hole 1 inch from one end. Use a piece of nail for the pin, and place it in the small holes in the short rod and horizontal lever. Rivet the ends of these pins so that they can not slip out. Fasten a contact spring to the end of the long rod which is nearest the pin, then mount it on the base so that the other end comes under the thumb screw as indicated. A spring is fastened to the long rod to pull the contact down on the mineral, as shown in Fig. 1.



Novel Detector in Which the Mineral Cup Is Held in Place by a Steel Magnet.

Next procure a small steel magnet such as that used in telephone receivers and secure it on the base where the cup is to rest. Solder a small piece of iron ¾x⅛ inch (Fig. 2) on a mineral cup. When placed on the magnet it will stay in any position in which it is put and thus affords easy adjustment.



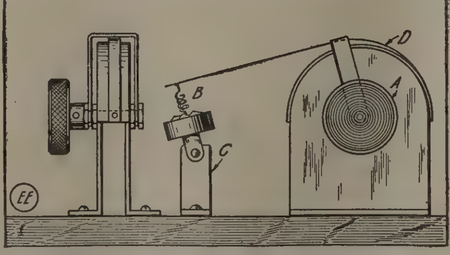
Details of Detector Having Magnetic Cup Retainer.

Contributed by AN EXPERIMENTER.

NOVEL DETECTOR STAND.

As will be understood from the illustration of this unique detector, when the knob A is turned to the left it bends the spring D more and therefore compresses the detector spring B. When turned to the right it releases the spring B. The stand C is made with a swivel so as to reach all parts of the mineral. The detector can be built easily by following the illustration carefully.

Contributed by HAROLD S. DUEY.



Unique Adjustment for Mineral Detector.

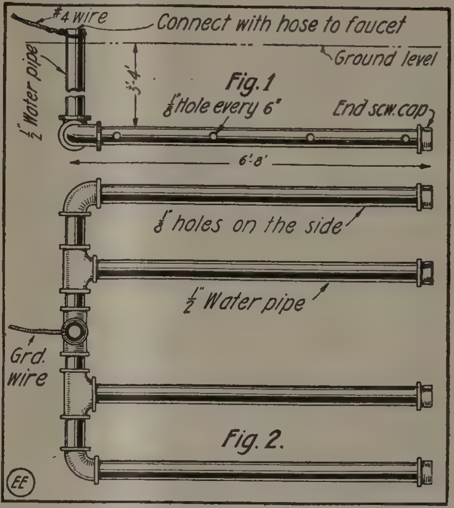
EFFICIENT IRON PIPE RADIO GROUNDS.

The illustration gives details of the type of earth in use on my radio station, and I submit same for the benefit of other readers.

The piping consists of ½-inch water pipe, with the necessary ⅛-inch holes, bends, end caps and tee joints where shown on the drawing in Figs. 1 and 2. This outfit is buried about three to four feet deep in the earth and to the part projecting above the ground the ground wire is soldered or connected with a ground clamp.

The general layout of the installation can be seen by reference to the sketch, but can be changed to suit the individual tastes of the experimenter; the larger the area covered the better the earth connection.

To put the apparatus in working order, a hose is bound tightly to the projecting part of the piping, and the other end connected to the faucet. On turning on the water the pipes will be filled and all the ground for a considerable distance around will be saturated with water, thus increasing the intensity of signal.



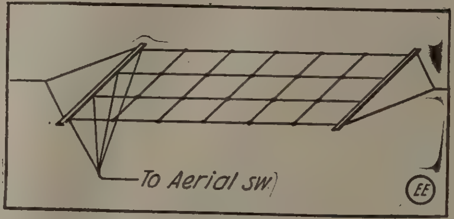
By Pouring Water Down Thru This Multiple Pipe "Ground" a Good Earth Connection Is Assured.

Contributed by JOSEPH G. REED.
New Lambton, Australia.

CHECKERBOARD AERIALS.

I have read of several types of aerials in THE ELECTRICAL EXPERIMENTER, but I do not remember ever having seen this type.

This type originated in the Navy, to the best of my knowledge, during the year 1909, and was first used on board the U.S.S. *Marietta.* The increase in sending radius was very satisfactory, as prior to its use the maximum distance transmitted over was 100 miles; after adoption, 300 miles. Previous to this both the straight "L" and "T" aerials were used.



An Efficient Aerial Design.

Shortly after this type was installed on the U.S.S. *Marietta,* the *Chester, Birmingham* and *Salem* were fitted up, and the results proved the excellence of the checkerboard in what were known as the 2,000-*mile tests.* Not only did the checkerboard give greater radiation, but it proved more stable, because the metallically interconnected cross-wires were of ⅛-inch solid brass, acting not only as conductors but spreaders also. In high winds and when lowered for repairs it did not tangle.

Contributed by L. E. FETTER.

THE CONSTRUCTOR

A Small Panel Type Radio Transmitter

By M. B. Sleeper

THE tendency of present-day designers of wireless apparatus, both experimental and commercial, is to mount the instruments permanently upon a vertical panel. Although receiving sets are usually encased, sending instruments are usually exposed, because the apparatus is less delicate, and because the difficulties of entire panel control make it necessary to adjust some of the instruments from the back. A number of highly efficient panel sets for commercial use have been designed by several manufacturers, but the amateur operators have had considerable difficulty in grasping the few underlying principles and reasons for a panel transmitter. To judge from the appearance of many home-made sets, the operators mounted their instruments with the single idea that they must not fall off. In planning the panel set there are seven points to keep in mind. Short leads, perfect insulation, maximum efficiency from each instrument, simplicity, convenience in adjusting, stability and appearance.

The set described in this article, Fig. 1, combines as far as possible, all of these considerations. The grouping of the separate instruments greatly shortens the leads, the arrangement minimizes any insulation losses, careful designing makes the instruments as efficient as possible, without the use of a more elaborate spark gap. There are no extra parts but every convenience for adjusting with a stability and appearance which will stand the hardest use and most critical examination.

The Transformer. Although the transformer especially designed for this set is rated at only 100 watts, any standard transformer of ¼ or ½ K.W. can be used by making the changes mentioned in the paragraphs on the condenser and oscillation transformer constants. A 100-watt size was chosen here because many amateurs wish to build their own, but cannot construct a larger transformer of ¼ or ½ K.W. capacity. Moreover, this size is economical to run, yet it can transmit up to twenty-five miles, or much farther when the receiving set is equipped with a vacuum amplifier.

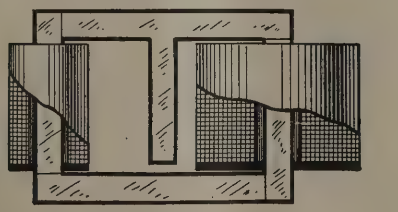


Fig. 2

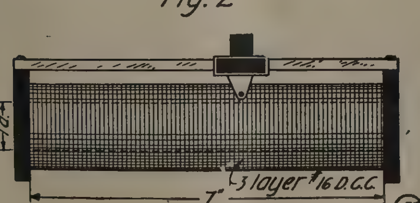


Fig. 3

Details of Magnetic Leakage Transformer and Adjustable Choke Coil.

Fig. 2 shows the arrangement of the core and the windings. A magnetic leakage gap, as in the drawing, increases the efficiency and makes the transformer self-controlling, or more independent of external impedance than the straight closed-core type. However, the Marconi sets use impedances with closed core transformers to adjust the current supply. If the magnetic leakage gap is not used the impedance coil must be employed to regulate the current flow.

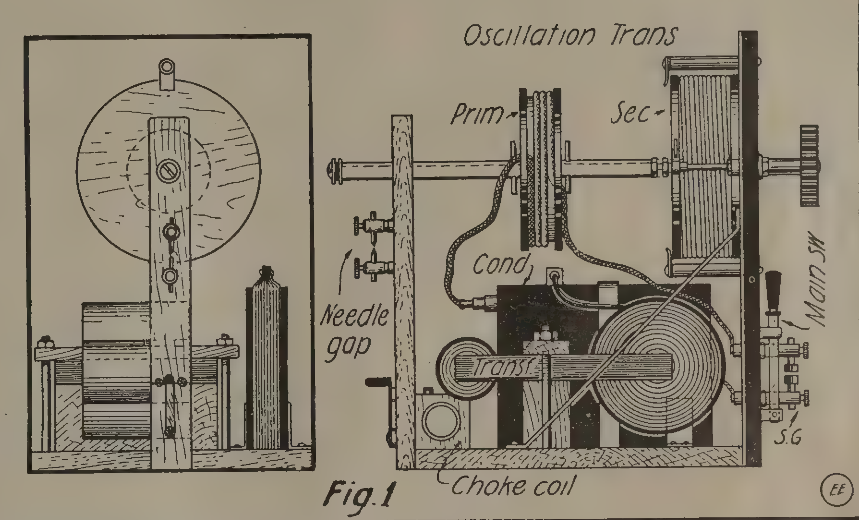


Fig. 1

Efficient Design for 100-Watt A. C. Transformer Panel Type Control Radio Sending Set. Note Compactness, with Consequent Short Lead Connections. Oscillation Transformer May Be Adjusted by Knob on Front of Panel. A Hot-wire Ammeter may be Mounted at the Top of the Panel to Indicate the Radiation Current.

The core of the transformer is 8"x6", built up 1" thick of thin strips of soft iron, in the way described in all books covering wireless work. If the magnetic gap is used, it will be necessary to cut the strips on one side in two pieces, so that alternate strips of the gap may be inserted. When a good supply of iron is available, however, it is better to cut the side and the magnetic gap in one piece. A covering of empire cloth ⅛-inch thick is used to insulate the primary and secondary legs. The fibre-coil ends should fit tightly over the insulation. The primary requires 175 turns, or ¾ pound of No. 18 D.C.C. wire. For the secondary 31,800 turns, or 5½ pounds of No. 34 D.C.C. wire is needed. Each layer of both the primary and secondary coils should be carefully and evenly wound. A covering of empire cloth is put over each layer of wire as no pies or sections are used in this design. The number of turns in the coils are important and should not be changed. This transformer is designed to give a secondary voltage of 20,000.

As shown in Fig. 1, wooden blocks are placed beneath the center of the transformer coil, while a clamp across the top, held by a bolt at each end, retains the transformer in place. This transformer when used with the adjustable choke coil is highly efficient.

Choke Coil. Fig. 3 gives the details for the choke coil, while Fig. 1 shows it mounted at the back of the set. A slider is used for fine adjustments, and a switch, on the oscillation transformer support, cuts in the layers. In making adjustments it is best to cut in all the turns; then decrease the number, noting by test the point of maximum efficiency. This is the first close adjustment to make in tuning the set. If, as the turns are cut out, the transformer becomes hot, more resistance must be cut in.

Condenser. For every transformer there is a certain capacity which must be used with it, depending upon the output and secondary voltage. If the condenser is too small it will discharge too quickly, with insufficient force, or, if too large, it cannot be properly charged. If any operators wish to use a transformer of more than 100 watts they can calculate the required condenser capacity by the formula:

$$C = \frac{1{,}000{,}000{,}000 \times K.W.}{nV^2}$$

where

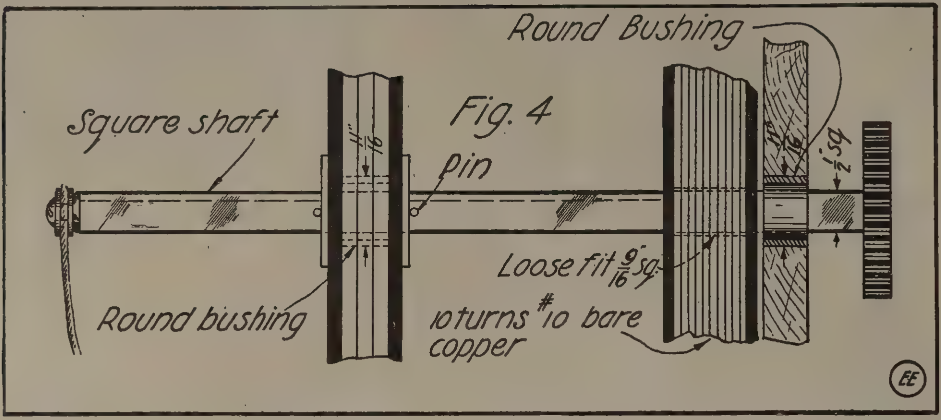
C = capacity in microfarads.
K.W. = output of transformer in kilowatts.
n = cycles of primary supply current.
V = secondary voltage.

Practically all reliable manufacturers give the voltage of their transformers, so that the calculation of the required capacity is not difficult.

Knowing the required capacity, the size of a glass plate condenser can be figured very closely by the formula:

$$A = DC \times 556{,}189.$$

where
A = area in square inches of tin foil.
D = thickness of glass plate in inches.
C = capacity of condenser in microfarads.



Turning the Knob at Right Changes the Wave Length. Sliding It in or out Decreases or Increases Oscillation Transformer Coupling.

The condenser for this particular set consists of seven sheets of tin foil 4x6 inches, separated by glass plate 6x8 inches. A tab from every other plate is brought out at the top of the condenser, while the other tabs are at the back. In tuning the set the flat jaw test clip can be set on any number of these connections. Copper foil, although rather expensive now, is far better than tin foil. Copper foil is much lighter, lies flat, and does not tear even under considerable strain. A thickness of .005 inch is usually employed. The complete condenser should be tightly taped and boiled in an insulating compound. Two sets of angle clamps, fastened to the base of the set, hold the condenser in position when it is completed.

Spark Gap. The spark gap in this set is not as important as when a larger transformer is used. A small quenched gap can be used in place of the one in the drawing, but this will not increase the sending range appreciably. The support for the electrodes are made of ½-inch brass rods, turned down at one end, to pass through porcelain tubes. This insulation prevents any losses by leakage across the wooden panel.

Oscillation Transformer. One of the most important considerations in this set is the oscillation transformer. The type described here has a primary inductance of 2797 cm., or just enough to give a wave length of 200 meters in the closed circuit. If a larger or higher potential transformer is used, the size of the condenser will increase, necessitating a reduction in the number of turns on the primary of the oscillation transformer.

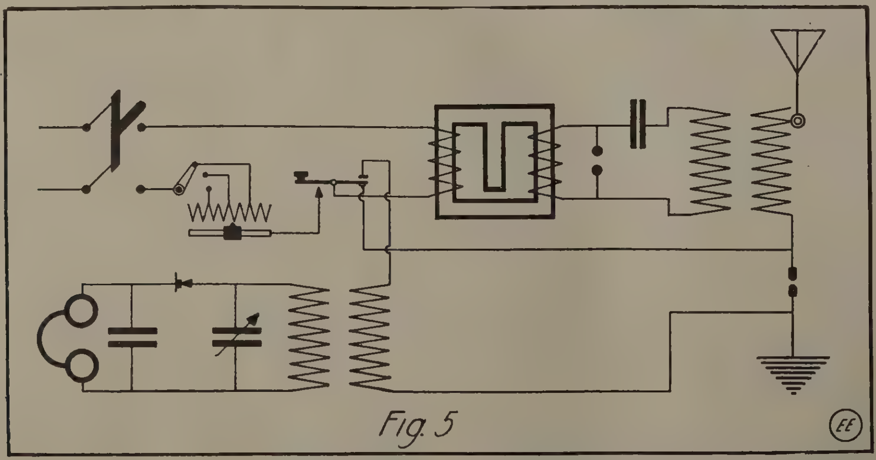


Diagram of Connections for Panel Type Radio Transmitter and Also the Receiving Apparatus.

The inductance of a cylindrical helix of one layer can be calculated from the formula:

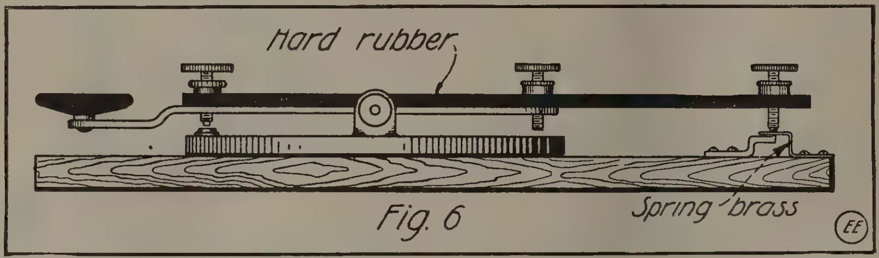
$$L = \frac{3(5D \times T)^2}{3P + D}$$

where
L = inductance of coil in centimeters,
D = diameter of coil in inches,
T = number of turns,
P = length of coil in inches.

Knowing the required capacity from the transformer calculation, and the required wave length, 200 meters, the proper inductance of the primary coil is calculated from the following expression:

$$\sqrt{L} = \frac{\lambda}{59.6\sqrt{C}} \text{ or } L = \left(\frac{\lambda}{59.6\sqrt{C}}\right)^2;$$

where
L = inductance of coil in centimeters,*



Special "Break-in" Key Used with Panel Type Transmitter Here Described.

C = capacity in microfarads,
λ = wave length in meters.

or, when λ is always 200 meters,

$$L = \frac{1}{.0888C}$$

Since the inductance is fixed, any tuning in the closed circuit can be done by adjusting the condenser.

The primary coil is wound on a solid wooden core 6 inches in diameter. The groove around the outside is just wide enough for three turns of stranded, high tension cable. Through the center is a hole 11-16 inch in diameter, or large enough to allow the ½-inch square rod to revolve in it. The coil is held in position on the rod by pins and washers on either side. Thus the control handle and center rod can be revolved freely, or the primary coil can be moved in or out to change the coupling.

The secondary coil is constructed to rotate, but can not move backward or forward. This core, too, is a solid block, with a groove on the edge. Bare wire, ⅛ inch in diameter, is used for the winding, with small cord 3-32 inch in diameter to space the turns. The trolley wheel, on a slider mounted through an insulator in the panel, makes contact with the wires. As the handle on the square shaft is revolved the coil turns, and the square slider tube moves along the square rod. By means of the spring to which the wheel is fastened, a good contact is always made with the wire.

The ground connection from the winding is made by a wire set down into the shaft, Fig. 4, running out to a screw at the end. A lug under the screw allows the shaft to turn without binding the wire. Small posts, on opposite sides of the coil, allow it to turn, but prevent it from moving as the handle is moved in and out. The holes through the panel and back support are large enough to permit the square shaft to revolve. When the set is adjusted the coupling is changed by moving the handle in or out, while the secondary circuit is regulated by revolving the handle.

Assembling. To attain the utmost efficiency, the set should be carefully assembled, with special care for the insulation. Wood is satisfactory for the panel, but if possible marble should be used. The front must be braced to make it rigid. The transformer and condenser are first mounted on the base, then the choke coil and switch are fastened on the back support. Double braid, rubber covered wire is used for the primary circuit connections between the main switch, transformer and choke coil. All secondary wiring is done with heavy high tension cable. The antenna is fastened to the end of the slider rod on the secondary of the oscillation transformer; the ground is connected to the lug at the end of the shaft, or to the lower binding post of the needle spark gap, if a break-in system is used.

Break-in System. No antenna switch is described in this article, as it is intended that a break-in system is to be used. This consists simply of a needle spark gap and one auxiliary contact on the sending key. Fig. 5 shows the method of connecting the apparatus, and Fig. 6 illustrates the contact on the key. Ordinarily the loose coupler is connected to the aerial through the oscillation transformer. When the key is pressed, however, the receiving circuit is broken, while the high frequency current jumps the needle gap to the ground. This is the most reliable break-in system, since it does not depend on relays, or elaborate contacts on the key.

The editor will be pleased to receive photographs of apparatus, built by experimenters, following the designs described in this article.

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*For an exact inductance formula refer to page 119 of the June, 1916, issue.

Water Wheel Drives for Private Lighting Plants

By H. Winfield Secor

PART II.

THE first paper on this subject which appeared in the July issue, gave the design and construction details for various sizes of water wheels. A few important mechanical considerations will now receive attention, such as the proper size of shaft for transmitting a given horsepower, speed ratio of various sizes of pulleys, etc.

The formula to use in determining the proper size of cold rolled steel shaft which carries pulleys is that given below:

$$D = \sqrt[3]{\frac{70 \times H.P.}{R}} \text{ or } H.P. = \frac{R D^3}{70};$$

Where:—

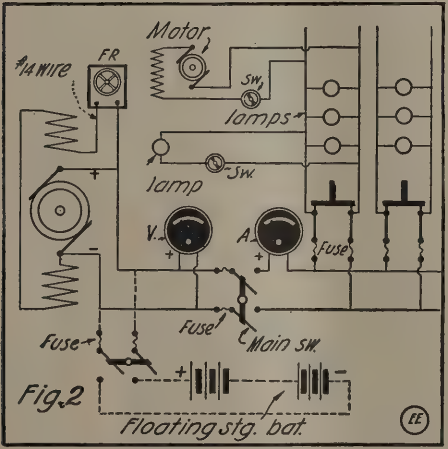
D=the diameter of shaft in inches

H.P.=horse-power to be transmitted

R=revolutions per minute of shaft.

One of the practical conundrums encountered by those constructing their own lighting plant is that involving the proper speed at which to drive the dynamo. To begin with the dynamo will have a standard rating in volts and amperes, as well as speed in revolutions per minute (R.P.M.). A common speed for small dynamos of ½ and 1 K.W. size is 1000 to 1500 R.P.M.

A single example on the method of figuring the pulley diameters for belt transmission at various shaft speeds will help to clear up this matter. If, in Fig. 1-A, we have a pulley 1 mounted on the water wheel shaft, and join it to pulley 2 by means of a leather belt as indicated, the following holds true: If the driver pulley 1 has a diameter of 60 inches and rotates at 10 revolutions per minute, then the relative speed of pulley No. 2 will be as the ratio existing between its diameter, or six inches, and the diameter of the first pulley. The ratio between 6 and 60 is 10; hence pulley No. 2 will rotate at ten times the speed of the larger one at No. 1 position, or at 100 revolutions per minute. Supposing we mount pulley No. 2 on a counter-shaft, suitably supported on standard shaft hangers or pedestal bearings, and on this shaft we also mount a large pulley, No. 3, having a diameter of 50 inches. If the dynamo has a five inch pulley on its shaft, then the ratio between 5 and 50 is 10. Hence pulley No. 4 on the dynamo will rotate at ten times 100 R.P.M. or 1000 R.P.M. It is evident that in most cases, or at least where an ordinary size pulley only is used on the water wheel shaft, that the use of a counter shaft will be imperative in order to obtain a sufficient driving speed at the dynamo.



Typical Isolated Electric Lighting Plant, with Measuring Instruments, Voltage Regulator and Distribution Circuit Switches.

In some cases, however, an extra large pulley is used as indicated in Fig. 1-B. On the assumption that it is good practice to have the *driver* and *driven* pulley spaced on centers at a distance equal to *three times the diameter of the larger pulley*, it is evident that this arrangement will not be permissible in all cases as when the dynamo cannot be located at a sufficient distance from the large pulley. In compliance with the rule just stated, some very efficient commercial belt drives are in operation involving the proposition here under consideration, viz., where a large pulley must be placed by necessity quite close to a small pulley. The problem is solved very easily by the use of an auxiliary pulley known as an *idler*. The *idler* pulley is mounted on an adjustable iron arm or wooden block, so that the belt can be made to encompass at least 180 degrees of the circumference of the smaller pulley.

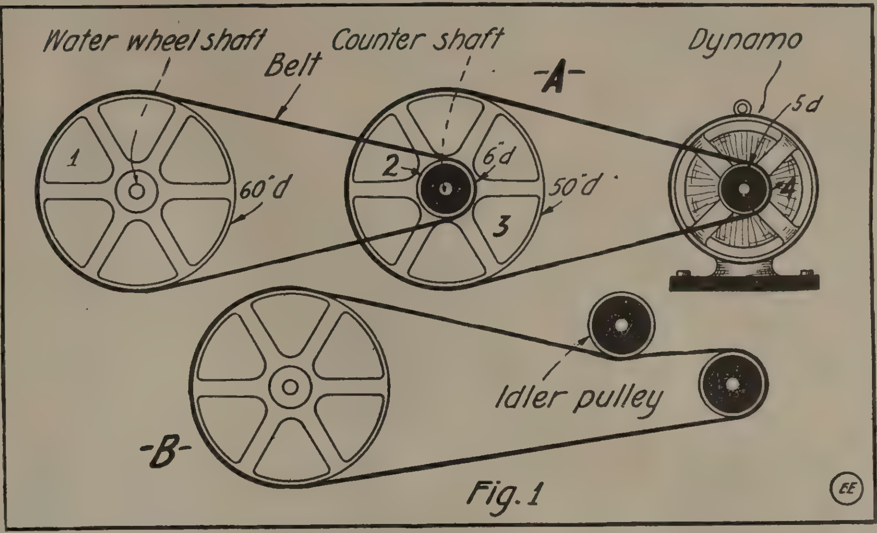


Diagram Showing Relations Between Various Pulley Diameters and Speeds, Also How an "Idler" Pulley Can Be Used Advantageously in Short Drives to Increase Belt Contact.

For small size plants rated at a few kilowatts only, a single belt will be all right for driving the dynamo. The horsepower and necessary width of belt are given by the following formulae:

$$H.P. = \frac{D \times R \times B}{1925} \text{ or } B = \frac{1925 \times H.P.}{D \times R};$$

Where:—

H.P.=the horse-power to be transmitted

D=the diameter of the small pulley in inches

R=the revolutions per minute of the small pulley

B=the width of *double belt* required in inches.

It is usually considered that a single belt will transmit about ½ the horse-power rating of a double belt. Leather belts are usually run with the smooth side to the pulley and they should be laced evenly so as to drive as smoothly as possible. No belt will drive as smoothly and evenly as a cemented joint belt for dynamo drives where slight fluctuations in speed are of paramount importance. This point is also taken care of to a great extent in well designed water power plants by the proper arrangement of automatic governors attached to the turbine or water wheel, which control the quantity of water supplied the prime mover.

Regarding the electrical features of private lighting plants, it may be said at the start that *tungsten* lamps should be used invariably, as they represent the highest efficiency with respect to the candlepower obtainable from a given input in watts. On direct current circuits the watts may always be obtained by multiplying the volts times the amperes; also the watts divided by the volts gives the amperes of current, or the watts divided by the amperes gives the volts' potential.

Volts	Lamp Watts	C. P.	Watts Per C.P.	Amps.
110	10	7.7	1.30	.09
110	15	13.0	1.15	.13
110	20	18.2	1.10	.18
110	25	23.8	1.05	.227
110	40	38.8	1.03	.364
110	60	60.0	1.00	.546
110	100	105.0	.95	.909

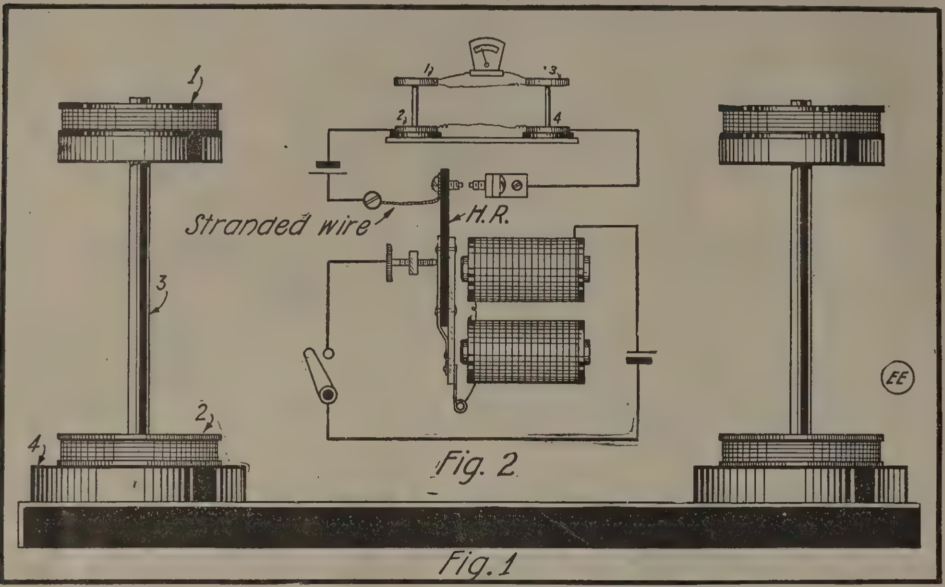
With these basic facts in mind and by the aid of the appended table giving data on standard sizes of Mazda tungsten lamps and their energy consumption, it is an easy matter to compute the amount of energy required for a given number of lamps, and

(*Continued on page 291*)

Line Volts	Percentage of Loss					
220	2.7	2.2	1.8	1.4	0.9	0.45
110	5.2	4.4	3.5	2.7	1.8	0.90
52	10.3	8.8	7.1	5.5	3.7	1.90

Capacity Amperes Rubber Insulation	No. B. and S. Gauge	Actual Volts Lost					
		6	5	4	3	2	1
225	0000	59,280	49,400	39,520	29,640	19,760	9,880
175	000	47,040	39,200	31,360	23,520	15,680	7,840
150	00	37,290	31,075	24,860	18,645	12,430	6,215
125	0	29,580	24,650	19,720	14,790	9,860	4,930
100	1	23,460	19,550	15,640	11,730	7,820	3,910
90	2	18,600	15,500	12,400	9,300	6,200	3,100
80	3	14,760	12,300	9,840	7,380	4,920	2,460
70	4	11,700	9,750	7,800	5,850	3,900	1,950
55	5	9,300	7,750	6,200	4,650	3,100	1,550
50	6	7,380	6,150	4,920	3,690	2,460	1,230
35	8	4,626	3,855	3,084	2,313	1,542	771
25	10	2,910	2,425	1,940	1,455	970	485
20	12	1,830	1,525	1,220	915	610	305
15	14	1,152	960	768	576	384	192

Making a Hughes Induction Balance



An Induction Balance Whereby Difference in Coins, Such as "Counterfeit" Can Be Quickly Detected. Normally the Two Upper Coils "Buck" the Two Lower Ones, Giving Zero Deflection on the Galvanometer.

The Hughes induction balance is an apparatus seldom found in an experimenter's workshop. This is probably because the instrument and its uses are not as well understood as those of the more common apparatus. One particular for the induction balance is in the detection of counterfeit coins, as in Mr. Benson's story of the Wireless Wiz. It is also possible to compare the strength of magnets, the conductivity of metals, the sensitivity of telephone receivers, or to measure the difference in frequency of two alternating current circuits.

The induction balance is composed of four coils, two in the primary and two in the secondary circuit. When the relative positions of the coils are adjusted correctly, the inductances neutralize each other and no current flows in the secondary circuit. If, however, the slightest change is made in any of the coils, such as by the insertion of any metal object, the mutual induction is unbalanced and a sound is made in the telephone receiver.

A balance for use in detecting counterfeit coins is pictured in Fig. 1. Two of these stands are required for the apparatus. Each spool is 3½" in diameter, wound with exactly 300 turns of No. 32 single silk wire, spaced evenly, layer on layer. Any difference in the windings will cause trouble when the coils are adjusted. A circular wooden piece, ½ inch thick, is glued to the underside of spool 1. In the piece is a ⅜ inch hole, making a tight fit on the upright 3. No nails or clamping screws can be used, as this upsets the induction balance. The base is large and heavy enough to support the upright and spools. Lead wires, about two feet long, are used to connect the coils.

Fig. 2 is a diagram of connections. The secondary coils are connected in series with a galvanometer. An experimenter who has no galvanometer can purchase an inexpensive Weston ammeter. When the shunt has been removed, this will serve very well as a galvanometer. Some form of interrupted primary circuit is necessary to induce currents in the secondary. An interrupter, mounted on the armature of a buzzer, serves for this purpose. When the key is closed the interrupted primary circuit induces a current in the secondary, causing the galvanometer to deflect until the inductances are evenly balanced.

To balance the circuits so that the inductances neutralize each other and there is no deflection of the galvanometer, it is first necessary to make sure the secondaries are placed on the uprights with the windings in opposite directions to the primaries. This done, the coils are carefully moved up and down until the needle of the meter is at zero. A more satisfactory indicator is a 75-ohm receiver, but in the story of the Wireless Wiz, for instance, a galvanometer is essential.

For detecting counterfeit coins, a genuine coin is placed in the hole through one secondary coil and the apparatus is balanced. Any other good coin of the same size will also balance the inductance, but if a counterfeit is inserted there will be a deflection of the indicator, or a sound in the telephone receiver. This effect is caused by a difference in conductivity of the metals. The insertion of the coin changes the mutual induction of the coils, the amount depending on the metal.

The sensitivity of receivers can be compared by inserting a variable high resistance in the primary circuit. The receiver which gives a sound with the greatest resistance cut-in is the most sensitive. Of two magnets, the one giving the greater unbalancing effect when held a given distance from one secondary, and directly over the center, is the stronger.

When the difference in frequency of two alternating currents is measured, one circuit is connected to coil 2 and the other circuit to coil 4. The current in the secondary coils will give beats; that is, the sound will grow strong, then weak. The number of beats per second is the difference in the frequency in cycles.

CORRECTION!

On page 152 of the July number the caption under the illustration showing the Navy men radiophoning to a battleship at sea should have read: "J. J. Carty, extreme left; U. N. Bethel at left of Secretary Daniels; Capt. Bullard second to right of Mr. Daniels; and Bancroft Gherardi, Mr. Carty's able assistant, between Mr. Carty and Capt. Bullard."

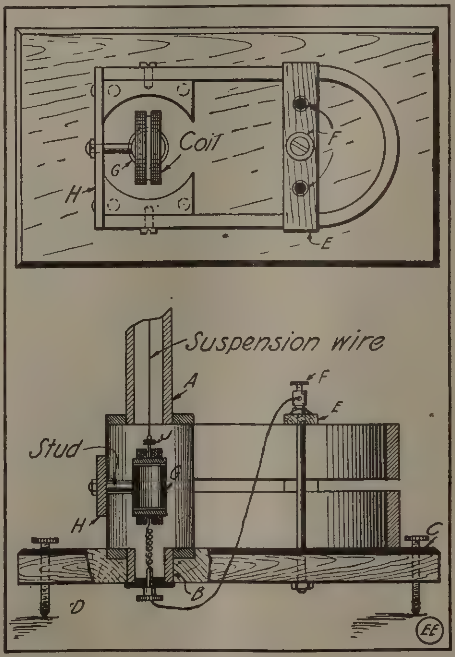
GALVANOMETER FROM TWO-BAR TELEPHONE MAGNETO.

Being in need of a sensitive galvanometer, and as the price of such an instrument was beyond my means, I constructed a very good one from parts of an old two-bar telephone magneto. The illustrations give an idea of its appearance. The brass bearing heads of the magneto were drilled out and brass tubes A and B were soldered in them. The top of the tube A was fitted with a brass cap, and a small brass rod with a set screw was arranged to hold the coil-suspension wire. The tube B was fitted with a black fiber cap, brass bushing and thumb-screw, to which was fastened the other terminal from the coil.

The instrument was mounted on a well-varnished wooden base C, with three leveling screws D. The magnets were fastened in place by a bolt through the base C to a fiber bar E supporting the two binding posts F. One binding post is grounded to the instrument and the other is connected by a wire to the terminal on the end of B. A core G for the coil was made from ¾-inch water pipe (not galvanized) filed up smoothly and held centrally in place by a short stud from a brass plate H fastened across the pole pieces.

The suspension system was next to be considered. A coil mount was made of thin strip brass, bent to rectangular shape, the ends being butted and soldered. A small brass wire hook was soldered in the center of one end for suspension. A coil of No. 40 B. & S. gauge enameled copper wire was wound upon the mount, leaving the ends long enough to suspend the coil from the top of the tube A and for a "pig-tail" terminal connection at the bottom of the tube B. The coil was wound to a resistance of about 2,000 ohms. A small piece of mirror J was cemented to the hook. The coil was then given a coat of thin shellac.

This type of instrument must be used with a scale on the wall and a source of light which is reflected onto the scale by the mirror. If extra resistance is added and calibrated with a standard instrument it may be used as a volt-meter. This instrument was inexpensive to construct and has served its purpose admirably.



How a Two Bar Magneto was Converted Into a Sensitive Galvanometer. An Instrument Every Experimenter Should Have.

Contributed by VERYL FULLER.

HOW TO MAKE IT

This department will award the following monthly prizes: FIRST PRIZE, $3.00; SECOND PRIZE, $2.00; THIRD PRIZE, $1.00.

The idea of this department is to accomplish new things with old apparatus or old material, and for the most useful, practical and original idea submitted to the Editors of this department, a monthly series of prizes will be awarded. For the best ideas submitted a prize of $3.00 will be given; for the second best idea a $2.00 prize, and for the third best a prize of $1.00. The article need not be very elaborate, and rough sketches are sufficient. We will make the mechanical drawings.

FIRST PRIZE $3.00

COMBINATION TELEPHONE AND TELEGRAPH SYSTEM WITHOUT BATTERIES.

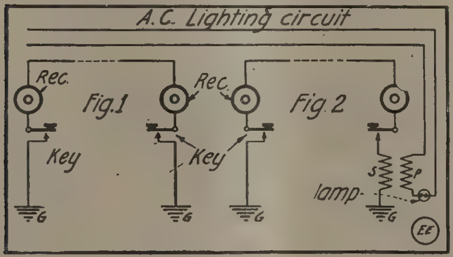
Many neighbor boys wish to put up a telegraph and telephone line between two rooms or houses. One of the easiest constructed circuits consists of one wire and a ground connection at each end. All the apparatus necessary is two telegraph keys and two telephone receivers.

Connect the instruments as shown in the diagram, with the keys closed. In telephoning the receiver is used to receive and to transmit. When the voice waves strike the diaphragm it is set to vibrating in harmony with the air waves. With each movement of the diaphragm the flux of the magnets is changed and this change of flux generates an electro-motive force which causes a small current to flow in the coils of the magnets. This current, which is in phase (harmony) with the voice waves, is transmitted along the wire to the other receiver and here the opposite operation takes place, i.e., the varying current is converted into speech.

The telegraph system uses the same circuit but the energy is obtained from the inductive effect of the sixty cycle lighting circuit running parallel to and near the telegraph wire. (See Fig. 1.) When one key is closed and the other one closed intermittently the induced current produces a clear singing tone, dot and dash fashion, in the receiver at the other end.

As an improvement on this, for the hum is usually quite faint, a small coil may be constructed. Put about fifty turns on the primary and about ten on the secondary. Connect the primary in series with a low C.P. 110 volt lamp and the secondary in series with the telegraph line. (See Fig. 2.) In this case it will be necessary to turn off the light when using as a telephone.

Contributed by R. C. GIESE.

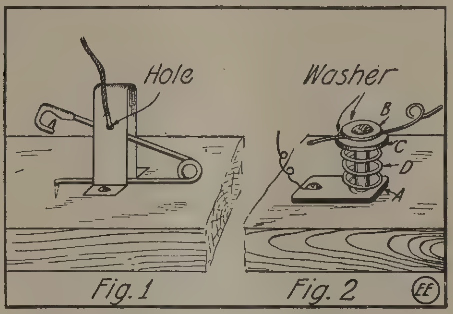


The Current for Operating This Telephone and Telegraph System Is Obtained Inductively from the A.C. Lighting Circuit.

SECOND PRIZE $2.00

INSTRUMENT TERMINALS MADE FROM SCRAP.

The terminals illustrated are in some respects more convenient than the ordinary forms on the market, and have the additional advantage that they can be made from scrap material. Fig. 1 shows a simple spring terminal suitable for experimental apparatus in which connections have to be altered frequently. It consists of a narrow saddle or arch made from ½-inch brass strips, and stands ⅝ inch high, the thickness of the arch being about 1/16 inch inside.



Simple Yet Effective Wire Connectors of Home-Made Construction.

This is screwed to the base as at B; one of the screws serving to hold one of the wires in the circuit. A small hole is made through both sides of the arch as seen at A, and a portion of a brass safety pin is bent at right angles and screwed to the base, the other arm passing through the arch and bent into a loop as shown. By pressing this loop down, and inserting the wire through the hole, a connection can be made instantly, without any screwing and unscrewing. The pressure exerted by the pin as it springs back, holds the wire firmly in position.

A different form of spring terminal is shown in Fig. 2. A small strip of brass forms the base plate, A, which has a small hole at one end, and a larger one at the other. This is attached to the base board of the instrument with a small wood screw, around which is looped the wire that is to be permanently connected. A 1-inch brass screw is passed through the other hole in the bed plate and screwed into the wood for half its length. Before this is done, however, two small washers, B and C, must be cut from stout sheet brass. The smaller is soldered to the underside of the screw head, while the latter slips on loosely. A short but strong spiral spring D, is then slipped on, after which the screw may be inserted in the wood. To connect a battery wire, press down the large disc, loop the wire around the screw and release it. The spring holds the wire tightly enough to ensure efficient contact.

Contributed by H. J. GRAY.

THIRD PRIZE $1.00

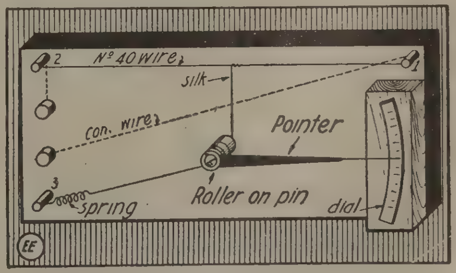
A HOT-WIRE BATTERY TESTER.

Smooth up a board about 3 inches by 7 inches and ¾ inch thick. Fasten three screws into three corners of the board, as shown in the diagram. Between the screws 1 and 2 stretch taut a piece of No. 40 copper wire, the kind used in telephone receivers. Connections from each end of the No. 40 wire are made to binding posts on the left end of the board.

Next roll up a piece of paper ⅜ inch wide by 1 foot long. The end of the paper should be glued down so that it will not unroll. Stick a pin in one of the circular ends and push it through all the way. If the roller will not spin freely on its axis (the pin) the hole must be enlarged. Push the pin with the roller on it into the center of the board. Next tie a silk thread very tightly onto the middle of the No. 40 wire. Pass the free end of the thread down and around the roller one or two times. The free end is then fastened to a short section of rubber band or, still better, a small spring which has previously been fastened to screw 3.

A suitable pointer is then glued to the roller in such a position as to move over a dial on the right end of the board. The dial can be calibrated as the constructor desires.

This "battery tester" works on the principle of the hot wire ammeter. When a current is sent through the thin No. 40 wire it becomes slightly longer, which in turn lowers the silk thread, the slack of which is taken up by the rubber band or spring, thus revolving the pointer. Contributed by ELLIOTT R. WEYER.



Handy Battery Meter Operating on the Hot-Wire Principle.

USING THE "E. E." AS AN ENCYCLOPEDIA.

The following scheme has been found advantageous for utilizing the wealth of information found in the "E. E." A neat alphabetical index is kept in a blank book containing the titles of articles written in the magazine. This has been found particularly helpful as supplementary reading to school work in chemistry and physics. When taking up "Radium," for instance, by referring to the index, a complete and *interesting* article (as distinguished from the dry theory of the text book) was found in the September, 1915, issue. Again under the heading of "telephone transmitters" was found a complete article on their construction and at least five minor references to them.

Contributed by A. READER.

To reverse the rotation of a shunt motor transpose the field terminals where they connect with the armature brushes. For series motors transpose the field terminals. Compound motors are reversed by transposing the armature terminals or both shunt and series field terminals.

OUR "PERPETUAL CLOCK" CONTEST.

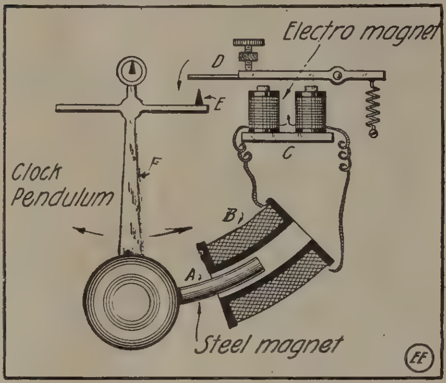
In our June issue we published the following problem:

To those sending in the most concise and accurate statement as to why the electrically operated clock described herewith will or will not operate perpetually, we will give one year's subscription free to The Electrical Experimenter magazine.

The proposed electric clock has a regular swinging pendulum F, carrying a cross arm or projection E, at its upper extremity and at its lower end a permanent steel magnet A. Now suppose the clock is started by giving the pendulum a push. When this action takes place, the magnet moving through the hollow core of the solenoid or magnet winding B, produces a current therein and this current acts upon two electro-magnets C. The moment they are energized in this way they attract an iron armature D, which in its downward travel strikes the projection E attached to the pendulum rod, thus causing the pendulum to swing backward and repeat the operation. Apparently this device will keep on working to the end of time, the only difficulty being that it doesn't! Why not?

To facilitate our handling the replies, we requested that the answers to this problem be stated in "fifty words or less."

We were astounded at the number of replies received. 2009 answers were actually sent in to us, *and of these 2009 replies, not one was thought correct!* Not one covered the main feature, showing why the device cannot work.



Proposed "Perpetual Motion" Electric Clock Puzzle, the Answer to Which Appears Herewith.

Nearly 50 per cent. of the replies took it for granted that the device would work for a considerable length of time, although we specifically stated that it could not. Most of these correspondents seemed to think that the bearing or the other parts would wear out in time. This they considered the main feature. Any machine working for a great length of time will have worn out parts, but if a perpetual motion machine could be invented—and it never will—worn out parts would not be a drawback. The machine would still give practical perpetual motion in a broad sense.

Many other replies had it that heat losses would keep the apparatus from working continuously. Next came those claiming losses due to hysteresis or eddy currents set up. These latter came nearer the truth than most of the others.

A good sample of the hundreds of letters received, follows:

"Extraneous energy imparted to pendulum, causing oscillation, will be expended as frictional heat, i.e, at fulcrum atmospheric resistance and magnetic retardation. Steel magnet produces stationery field. Moving pendulum energy produces electricity, by causing this field to pass through solenoid. Electro-magnets give back some energy minus transformation loss as heat. After all energy has been converted to heat, force or gravity will bring pendulum to rest."

And the problem seems so simple of solution! Take an ordinary telephone magneto generator. While the current remains open the handle can be worked easily—no electrical work is performed. Short-circuit the leads and the handles can be turned only with difficulty—you are performing electrical work now, by transforming your energy into heat. You also noticed, as stated, that the handle works harder with the closed circuit. In other words you experience a *damping effect.*

Exactly the same thing occurs when you plunge a permanent magnet into a spool of wire. As long as the circuit remains open there is no damping effect on the motion of the permanent magnet, as no electrical work is performed. Close the circuit and the motion of the magnet will be damped immediately. The reason why the magnet is damped when the circuit is closed is because the current generated in the coil circuit produces a strong magnetic field which acts in opposition to the magnet field of the moving steel magnet. In other words when a magnet is pushed into a coil it causes an inverse current to be set up in the winding or one flowing in such a direction as is opposed to the magnetic state of the moving core. This tends, therefore, to push the magnet back; likewise if the magnet attempts to leave the coil, the current induced in the latter will be in such a direction as to oppose the outward motion of the magnet. This is in exact accordance with Lenz's law, which states: "In all cases of electro-magnetic induction caused by mechanical movement the induced currents have such a direction that their reaction tends to stop the motion which produces them." A nice mechanical analogy can be found in the following: Referring to illustration, let us assume that B is a piston with A its plunger or piston rod. As long as the right-hand end of B is open, A will swing readily (open circuit). Now close the right-hand end of B and the swing of A will be arrested immediately (closed circuit—damping).

The correct answer to our problem, in less than fifty words, is, therefore:

As B and C form a closed circuit, the motion of A will be damped magnetically, due to the electrical work performed in the closed circuit. This damping effect is sufficient to bring the pendulum to a standstill after a very few oscillations.

A SMALL SYNCHRONOUS MOTOR.

A simple "synchronous" motor which can be run by an ordinary telephone magneto is shown in the illustration.

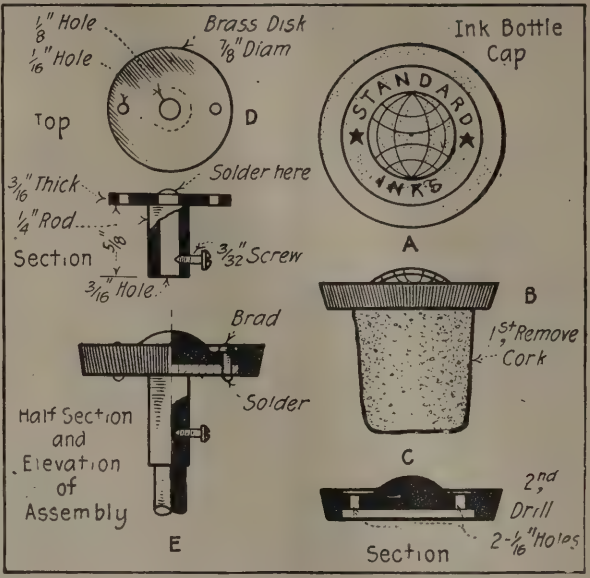
Referring to the drawing, N is a circle of wood 3"x½" with a center opening 2¼"x½", as shown. M. M are two disks of wood 4"x⅛", with central slots of the same size cut in them. The disks are fastened together by screws or glue and the space X is wound nearly full with No. 36 magnet wire. Another disk C, 2¼"x⅛" is now made and a pivot P is placed in the center upon which a permanent bar magnet (B), 2 inches long, is mounted in a manner similar to the mounting of compass needles. The disk is secured as shown in the illustrations and the whole is mounted on a suitable base by means of brass standards S. The terminals of the coils are fastened to the binding posts T, T.

AN "IDEAL" SWITCH KNOB.

In making electrical apparatus one often needs a reliable yet easily made knob, to fit a variable condenser, tuner, multi-point switch, or rheostat.

A convenient handle can be made in a jiffy from very little material.

Take the composition cap A from an empty ink bottle, say Waterman's Ideal Fountain Pen Ink, and remove cork B; then drill two small holes 1/16" as in C. The next step: empty your scrap box and find a brass washer or disc about ⅞" diameter x3/32" thick, a small piece of tubing or brass rod ¼x⅝" and a small machine screw 6-32 thread. Assemble as in D.



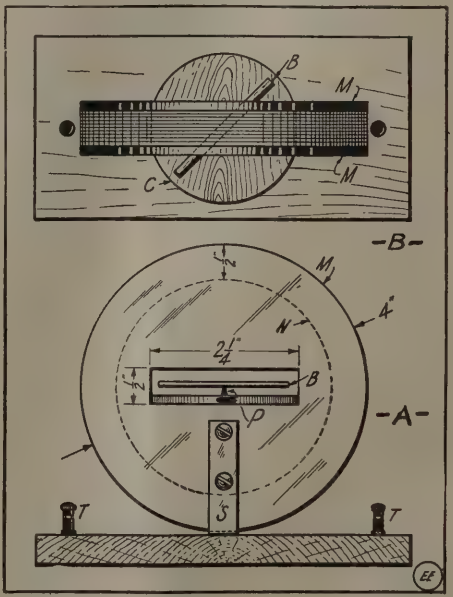
Constructing a Serviceable Switch Knob from Ink Bottle Cork.

Finally attach the rod and tube to the composition cap with two small brads and solder them.

Contributed by

ARTHUR J. PELLETIER.

In operation, the binding posts are connected to the terminals of a magneto. The magneto is started slowly, thus allowing the magnet to keep in step with the reversals of current, and is gradually speeded up.



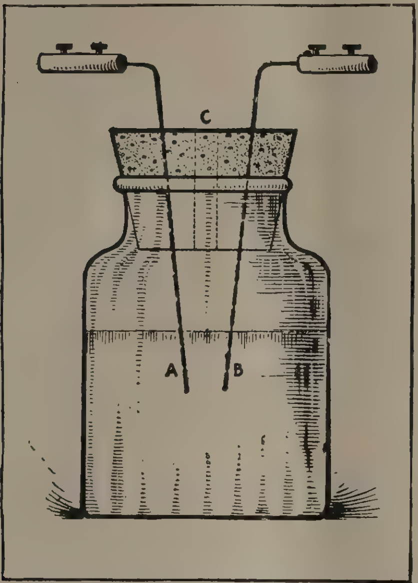
The Magnetic Needle Will Rotate in Step with the A. C. Passing Thru the Coil.

Contributed by WALTER D. SHOLL.

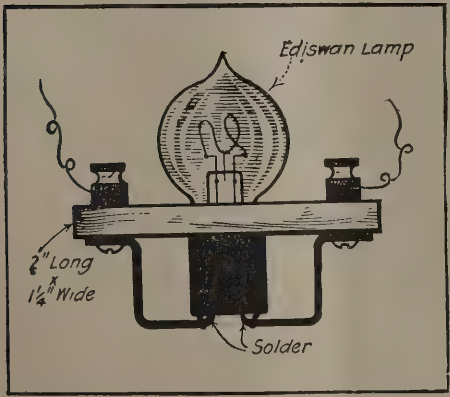
A CHEAP POLE FINDER.

A useful polarity indicator can be made at practically no cost in the following manner. Find a 3 or 4 ounce, wide-mouth bottle of clear glass, fitted with a good cork, and half fill it with water to which a pinch of table salt has been added. Push two stout brass wires, A and B, through the cork in a slightly slanting direction as shown in the diagram, bending the outside ends at right angles and fitting terminals, for making the necessary connections. A small hole C, must be bored through the center of the cork to allow the escape of gas. A "V" shaped notch cut or filed in the side of the cork will answer the same purpose. Adjust the wires so that their ends are about ½ inch apart. Upon passing a current, the wire connected with the negative pole will give off a much greater number of gas bubbles than the other. For weak currents, push the wires further into the bottle so as to bring the ends closer together or strengthen the solution by adding more salt.

Contributed by H. J. GRAY.



Useful Pole Testing Instrument Comprising Two Wires Immersed in Salt or Acidulated Water



Efficient Manner of Using Ediswan Screwless Base Battery Lamps by Soldering Two Wires to the Base Terminals.

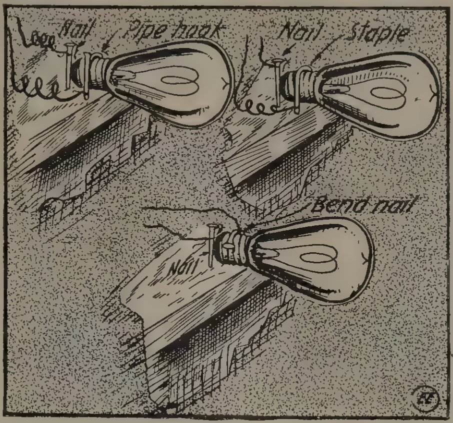
A BASE FOR AN AUTOMOBILE LIGHT.

Procure some quite thin wood, and drill a hole large enough to fit the light in the center. Next take two binding posts and fasten them to the wood in the manner illustrated. Then solder a piece of copper wire from the binding posts to each of the contacts on the light.

Contributed by FRANK E. WALKER.

THE "SIMPLEST" LAMP SOCKETS.

Herewith you will find an illustration of a simple lamp socket (per your note in the February, 1916, issue). The only materials required are a 3½-inch wire nail and a 1-inch nail. The longer nail is driven into the base of wood and bent "U" shape. The other nail is driven into the base about three-quarters of an inch behind the bent nail. One pole is connected to the bent nail and the other pole connected to the back nail.



How Three Budding Inventors Propose Making the "Simplest" Lamp Socket

Contributed by
BERTRAM WERTHEIMER.

SECOND DESIGN.

This socket consists of a staple and one nail. The staple is driven in at the end of the board and the nail one-quarter of an inch back of it. The lamp is then screwed in as in a regular socket.

Contributed by A. P. PECK.

THIRD DESIGN.

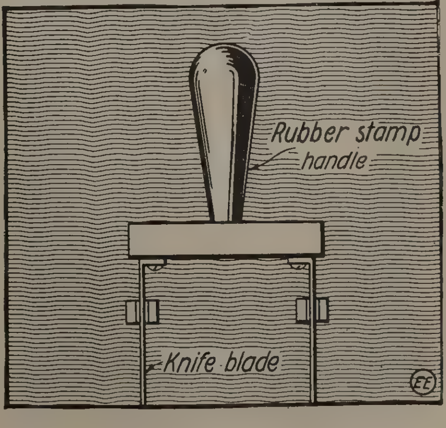
In answer to "The Simplest Lamp Socket" problem as shown in the February issue, herewith I submit design of a receptacle using only two pieces of material which are handy in every household—one nail and one pipe hook.

Contributed by
ALBERT E. PHILIPPS, JR.

A NOVEL IDEA FOR SWITCH HANDLES.

Having a few old rubber "hand stamps" around, I tried using them as handles for switches. They are very strong and make a neat appearance on my switchboard.

Contributed by JOHN GOLUBSKI.



Using Discarded Rubber Stamp Handles for Switches

TALCUM POWDER MAKES FROSTED BULBS.

Not having a frosted bulb and wishing to lessen the glare from an electric light over the dining-room table, I hit upon a scheme for frosting the bulb which proved very successful and which cost practically nothing to accomplish.

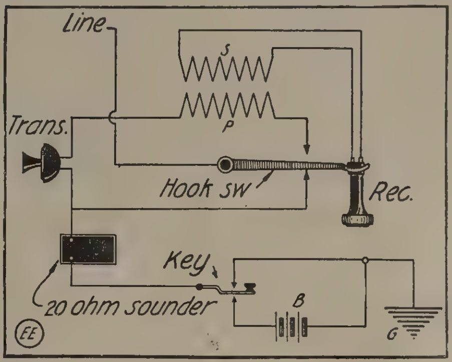
I removed the bulb from the socket and painted it with a thin coating of mucilage from the tip to about a quarter of the distance up the side. Then while the mucilage was still wet, I dusted the bulb with talcum powder, blowing off the excess so as to make a smooth finish.

To my surprise I found when the mucilage was dry that I had a neat, very efficient frosting and my makeshift repair is still in active use.

Contributed by
HAMILTON A. HOOPER.

CONNECTING A TELEPHONE TO A TELEGRAPH LINE.

This is a simple and unique way of connecting a telephone onto a telegraph line.



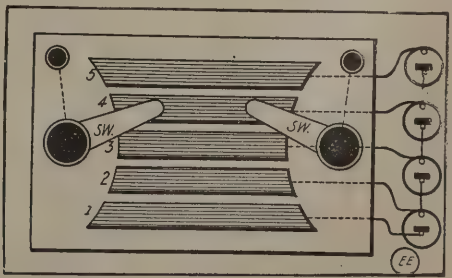
Simple Hook-Up for Telephoning Over Telegraph Lines

There may be some technical objections to having the sounder in the talking circuit, but it gives fine service on our line with four 20 ohm instruments connected as shown. This circuit would work on a closed circuit system as well, but we use dry batteries and avoid the gravity battery nuisance and expense. It is necessary that one telegraph key be kept down while the telephones are in operation. The main advantage is that it does away with all but one set of batteries at each station.

Contributed by LYLE C. ROLF.

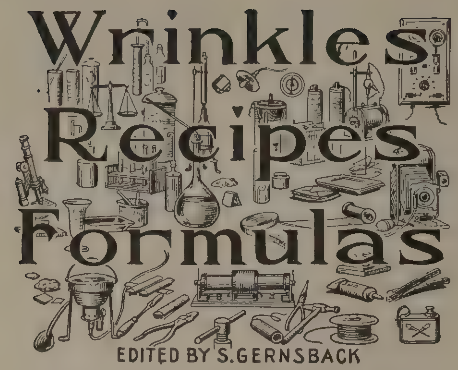
USEFUL POLE-CHANGING SWITCH.

The illustration herewith is of a pole-changing switch that also provides for a gradual increase or reduction of current. The material required is a piece of wood, 2½"x4", two switch levers, some thin brass or copper sheeting and two binding posts. The brass or copper is cut into strips ¼" wide. The illustration will explain the construction. SW indicates the switch lever; BB are the binding posts and 1, 2, 3, 4, 5 denote the brass strips. The apparatus to be operated is connected across the binding posts. This switch was designed for four batteries, but can be used with more by the addition of brass strips.



Handy Pole-Changing Switch Made of Two Switch Blades and Metal Strips

Contributed by CARL F. LUDWIG.



Wrinkles Recipes Formulas

EDITED BY S. GERNSBACK

Under this heading we publish every month useful information in Mechanics, Electricity and Chemistry. We shall be pleased, of course, to have our readers send us any recipes, formulas, wrinkles, new ideas, etc., useful to the experimenter, which will be duly paid for, upon publication, if acceptable.

FORMULA NO. 24

Quick Bronzing Liquids.

For Immediate Action on Copper, Brass, or Zinc.—Brown or Dark Bronze for Copper, Brass or Zinc.—Dissolve 5 drachms nitrate of iron in 1 pt. of water; or, 5 drs. perchloride of iron in 1 pt. water. A black may also be obtained from 10 ozs. muriate of arsenic in 2 pts. permuriate of iron, and 1 pt. water.

Brown or Red Bronzing for Brass.—Dissolve 16 drs. nitrate of iron, and 16 drs. hyposulphate of soda, in 1 pt. water, or, 1 dr. nitric acid may be substituted for the nitrate of iron.

Red Brown Bronzing for Brass.—Dissolve 1 oz. nitrate of copper, and 1 oz. oxalic acid in 1 pt. water, brought to the boil and then cooled..

Dark Brown Bronzing for Brass.—Mix 1 oz. cyanide of potassium, and 4 drs. nitric acid, with 1 pt. water.

Red Bronzing for Brass.—Mix 30 grs. tersulphate of arsenic, 6 drs. solution of pearlash, and 1 pt. water.

Orange Bronzing on Brass.—Mix 1 dr. potash solution of sulphur with 1 pt. water.

Olive Green Bronze for Brass.—Dissolve 1 pt. permuriate of iron in 2 pts. water.

Slate-colored Bronzing for Brass.—Dissolve 2 drs. sulphocyanide of potassium, and 5 drs. perchloride of iron, in 1 pt. water.

Steel Grey Bronzing for Brass.—Mix 1 oz. muriate of arsenic with 1 pt. water, and use at a heat not less than 180 degrees Fahr.

Bright Red Bronzing for Copper.—Mix 2 drs. sulphide of antimony, and 1 oz. pearlash in 1 pt. water.

Dark Red Bronze for Copper.—Dissolve 1 dr. sulphur and 1 oz. pearlash in 1 pt. water.

Copper Colored Bronzing for Zinc.—Agitate the articles in a solution of 8 drs. sulphate of copper, and 8 drs. hyposulphate of soda in 1 pt. water. S. G.

A GOOD TEST FOR COPPER

First take the solution supposed to contain copper and put it in a shallow vessel. When the solution is ready immerse a piece of iron or steel that has been cleaned of all rust. If the solution contains copper the iron or steel will be coated with metallic copper. Should copper not show in this test, pour in the solution a little ammonia; if copper is present a light blue precipitate will form and the solution will take on a blue color.

Making a Solid from Two Liquids.

Make up a transparent solution of zinc sulphate. Fill a glass half full of zinc sulphate solution and another half glass full of strong ammonia. Pour them together and if the proportion be properly calculated the two liquids will form a solid so apparently dry that on inverting the glass containing it not a drop will fall out.

Contributed by HAROLD RHAME.

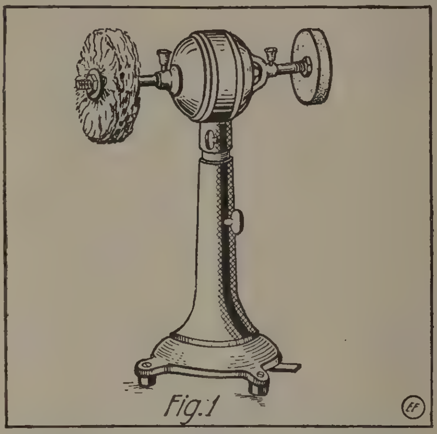
ACCIDENTS WITH ACIDS.

When strong mineral acids (nitric, sulphuric, and hydrochloric acids) are used for experimental purposes it is a good plan to keep some washing soda handy in case of accident. If acid is spilled on the floor or table, a little soda should be sprinkled over it at once, and afterwards removed with a wet rag. Another useful dodge is to keep a saucer on the table in which the glass stoppers of acid bottles can be placed when removed. Of course, the stoppers should be put back in the bottles immediately after use, not only to prevent fumes escaping into the air (in the case of nitric and hydrochloric acids) but also to preserve the liquids from dust and deterioration.

CONVERTING ELECTRIC FAN INTO BUFFER AND GRINDER.

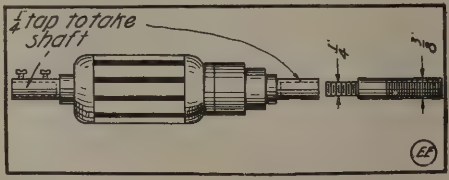
An ordinary electric fan may be easily converted into a buffer or grinder by drilling both ends of the armature with a number 6 drill, then tap it with a ¼-inch tap.

Take two pieces of ⅜-inch round iron, 4 inches long, and turn down about 1 inch on one end so as to cut a ¼-inch thread.



Converted Fan-Motor Serving as Buffer and Grinder.

The ¼-inch end is to fit in the armature shaft. On the other end a ⅜-inch thread is to be cut to take buffer and lock nuts. Two set screws are used on each side to keep buffer and wheel from loosening. The same work is performed on the other end of the shaft or an emery wheel may be used. This makes a very handy machine, suitable for grinding, buffing and polishing small instrument parts.



How Motor Shaft Is Extended by Threaded Sections at Either End.

Contributed by CHAS. JACOBY.

AN ACID-PROOF CEMENT

A cement which is proof against boiling acids may be made from India rubber, tallow, lime and red lead. The India rubber must be first melted by a gentle heat and then 6 to 8 per cent. by weight of tallow is added to the rubber while it is kept well stirred; next dry slaked lime is applied until the fluid mass assumes a consistency similar to that of soft paste; lastly, 20 per cent. of red lead is added in order to make it harden and dry. Contributed by

ARTHUR G. NORRIS, JR.

SOME INTERESTING CHEMICAL EXPERIMENTS.

Procure at a drug store, or elsewhere, some phenolphthalein. Dissolve as much of this as possible in one fluid oz. of grain alcohol (C_2H_5OH). Add water to this until a permanent milkiness is observed in the solution. Now add more alcohol until the cloudiness disappears. The solution is now ready for use, provided that it does not cloud when a small amount of water is added to it.

This solution of phenolphthalein, when used in the *wine trick*, described by Mr. W. A. Talmage, in the April issue of THE ELECTRICAL EXPERIMENTER, imparts an odor of alcohol to the wine-colored solution. Instead of using ammonia water (NH_4OH) in the third glass, use a solution of caustic soda ($NaOH$), since the caustic soda has no betraying odor as does the ammonia. For the same reason, use diluted sulphuric acid (H_2SO_4), instead of the acetic acid.

The following is an extremely interesting color experiment: Obtain some iodic acid solution (HIO_3) and either make or buy some sulphurous acid solution (a solution of sulphur dioxide in water H_2SO_3). Take definite proportions of the two solutions and mix them together. Note carefully the time of mixing. In about twenty or thirty seconds the solution will turn black and in about three seconds more it will turn colorless again. By varying the proportions of the ingredients the time intervals of the color changes will also be varied. For the same proportions of the substances the time will be the same. In this manner one can predict at just what second the changes will appear. It might be well to add that a fair amount of light (natural or artificial) is necessary for the success of this experiment.

Another so-called *freezing trick* depends upon the conditions existing in supersaturated solutions. If such substances as sodium thiosulphate (hypo) are dissolved in water at about 100° F. until absolutely no more of the crystals will dissolve, and the solution is allowed to cool, it will be *supersaturated*. This solution will become a solid mass if the smallest crystal of the hypo is allowed to drop into it. With a little dexterity the operator can pass his hand over the vessel containing the solution and secretly drop into it a small crystal of the salt. A weird effect is produced when the solution immediately becomes solid. The explanation of this phenomenon is that the cold solution contains more of the salt than it could normally hold at that temperature, and when even the tiniest crystal of the salt is dropped into the solution, the whole becomes a solid mass. The solution must be freed while hot from the surplus hypo and allowed to cool slowly.

Contributed by

ELLSWORTH G. D. PATTERSON.

MAGIC INK RECIPES.

Red Ink.—One drachm potassium thiocyanate to one-half ounce of water. Reagent—One-half ounce of ferric chloride to one ounce of water. Apply with a mop or brush and writing will appear red.

Blue Ink.—One drachm potassium ferrocyanide to one ounce of water. Reagent—Fifty per cent. solution of ferric chloride or other ferric salts.

Blue Ink.—One drachm potassium ferricyanide, otherwise called red prussiate of potash (note, not ferrocyanide, which is yellow prussiate of potash), to one ounce of water. Reagent—Strong solution of ferrous sulphate.

Black Ink.—Tannine (strong solution) for the writing solution. Reagent—Very strong solution of ferrous sulphate.

Glycerine gives the ink more "body."

Contributed by ELLISON FRAZER.

Experimental Chemistry

By Albert W. Wilsdon

Third Lesson

IN the previous article we dealt mainly with Physical and Chemical changes. Let us now learn the difference between physical and chemical division.

As our definition of Physical Division indicates, there are two common ways of dividing matter physically. The first is by cutting or crushing. The second by Solution.

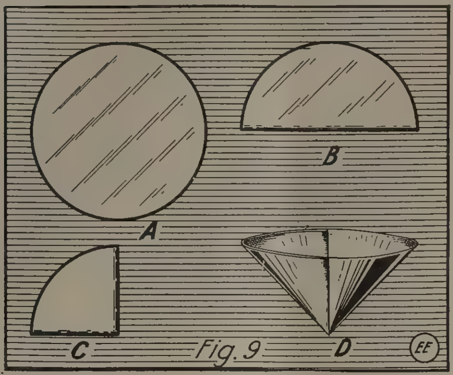


Fig. 9

Successive Operations in Folding Filter Paper Before Placing in Funnel.

If we should take a piece of sugar and keep cutting or crushing it until we could no longer divide it, we would still have the same substance, i.e., sugar, with the same identical properties. If we should dissolve sugar in water we would have a sugar solution, composed of water and finely divided particles of sugar. If we taste any part of the sugar solution, it would have the same characteristic sweet taste, as any other part of the liquid. We could recover the sugar by slowly evaporating the water.

The smallest particle which we could obtain by physical means and which would still retain the properties of the original substance is chemically termed a *Molecule*. The original piece of sugar which we started with was made up of a countless number of these small particles, or as we shall hereafter call them—Molecules.

We are about to begin using various reagents in our experiments, and undoubtedly most readers who are not familiar with the action of the various acids, etc., have a certain amount of fear when the word "Acid" is mentioned. They have all kinds of thoughts, of explosions, burns and what not. While the latter is very often the case if the operator does happen to let some acid come in contact with his skin (which is due to either carelessness or thoughtlessness, or both), on the whole there should be no fear of acids when handled according to the instructions.

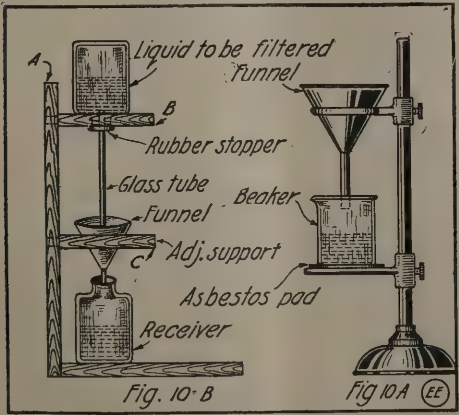


Fig. 10-B Fig 10A

Two Schemes for Filtering Liquids.

Do not let this fear of the different chemicals cause you to get excited, and thereby open an opportunity for some serious accident which could be averted by simply using a little care and proceeding according to directions.

If there is any danger attached to any of the experiments, you will be given special notice and ways by which to avoid them. As I have already said, and I again repeat with great emphasis, DO NOT BE AFRAID OF ANY REACTION, BUT PROCEED ACCORDING TO DIRECTIONS.

I might state here that if possible obtain your chemicals from a dealer. Do not depend entirely upon your druggist, as most of the chemicals which he has in stock are intended for medicinal use. Of course many amateur chemists will have to purchase their chemicals from the druggist, but when doing so, always state whether you want them in *crystal* or *powdered* form or in *diluted* or *concentrated* liquid.

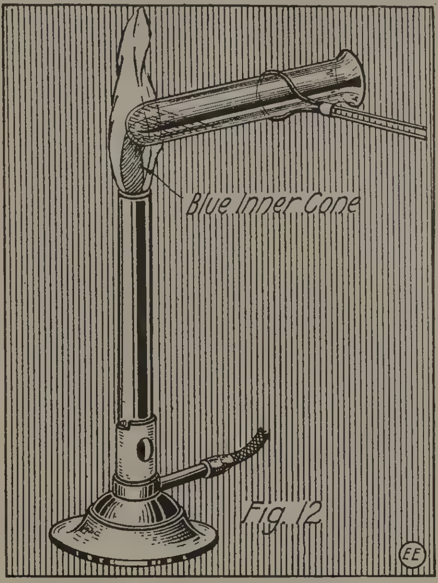


Fig. 12

In Heating a Test Tube Containing Solution Place It in Blue Flame of Bunsen Burner.

If they have not the form you require, do not purchase any substitute unless the experiment gives you the option of powder or crystals, etc.

In Experiment No. 7 it will be necessary to use diluted sulphuric acid [H_2SO_4]. Prepare the dilute reagent by adding 1 oz. of the concentrate acid to 6 ounces of water; proceed to mix it by carefully following the instructions as given in the *June* issue, under the heading *Laboratory Operations.*

Experiment No. 4—

Examine a few crystals of sugar. Notice the color and taste. Crush some (by placing in the mortar and crushing with the pestle) and if you have a magnifying glass or microscope, examine some of the powder. Taste some of the crushed sugar.

It still retains the same color and taste as the larger crystals before crushing.

Experiment No. 5—

Put about 5 grams of sugar in a clean dry test tube, and add about 10 c.c. of water. Shake the contents thoroughly by placing the thumb over the mouth of the tube (as shown in Fig. 11) and inverting the tube, shaking it back and forth. Do this for a few minutes and notice if the sugar dissolves.

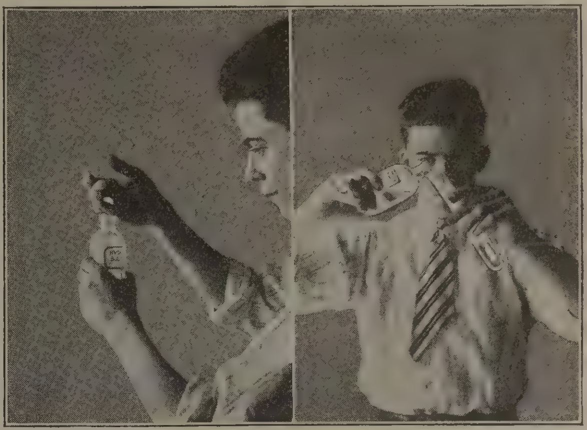


Fig. 8-A, (left), Grasp Glass Stopper of Bottle Between Third and Small Finger. Fig. 8-B, (right) Shows How to Thus Retain Stopper and Pour Out Liquid.

Apply the heat of the Bunsen burner, holding the tube in the flame by means of a test tube holder, as shown in Fig. 12. Keep moving the tube all the time and, if the liquid tends to boil over, remove it from the flame.

When all the sugar has dissolved, take the tube from the flame and cool it by allowing a stream of water to play upon the LOWER part of the tube. Taste some of the liquid. Save some of the liquid for Experiments Nos. 6 and 7.

By dissolving the sugar in water we have formed a *solution*. Sugar is said to be *soluble* in water, and water is a *solvent* of sugar. The sugar is termed the *Solute*.

On shaking the tube containing the sugar and COLD water, it will be noticed that the sugar does not readily dissolve. Upon applying heat, the sugar dissolves rapidly, therefore sugar is said to be *slightly soluble* in cold water, and *soluble* in warm or hot water.

Experiment No. 6—

Fold a filter paper, A, in halves, as at B, Fig. 9. Then into quarters, C, with one fold on the other, as shown at D.

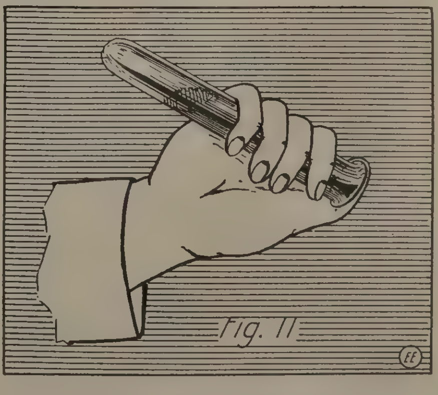


Fig. 11

Shaking Liquids in a Test Tube, Closing the Opening with the Thumb.

(*Continued on page 301*)

WITH THE AMATEURS

Our Amateur Radio Station Contest is open to all readers, whether subscribers or not. The photos are judged for best arrangement and efficiency of the apparatus. To increase the interest of this department we make it a rule not to publish photos of stations unaccompanied by that of the owner. Dark photos preferred to light toned ones. We pay each month $3.00 prize for the best photo. Make your description brief. Address the Editor.

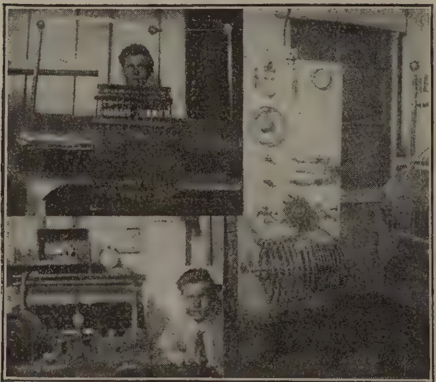
AMATEUR RADIO STATION CONTEST.

Monthly Prize, $3.00.

This month's prize winner.

ROBERT M. McLAIN'S RADIO STATION.

My receiving set is enclosed in a mahogany finished cabinet. The set comprises loading coils, loose coupler, two condensers, Audion and proper connections. All the instruments are home-made except 'phones and audion. I never miss NAA in fair weather and have good results from other stations. The transmitter is a 1 K.W. set built after my own design in one unit. The transformer, condenser, rotary gap, motor, rheostat and connections are all inside the cabinet. All connections are made of seven-strand cable. The condenser is adjustable. I made all the sending set except the motor and small switches at the top. The transformer is of the closed core type and gives excellent results. The transmitter represents the outcome of two years' work, but by using the material I had on hand it only cost me about five dollars when complete. The transmitter stands 40" high, 18" wide and 24" deep. The Tesla coil is excited by this instrument and was built from parts lying about my laboratory for fifty-five cents. My call is 5BS.



Mr. McLain's Station Is an Example of the Work Which Can Be Accomplished by Patience and Ingenuity.

ROBERT M. McLAIN.

Huntsville, Ala.

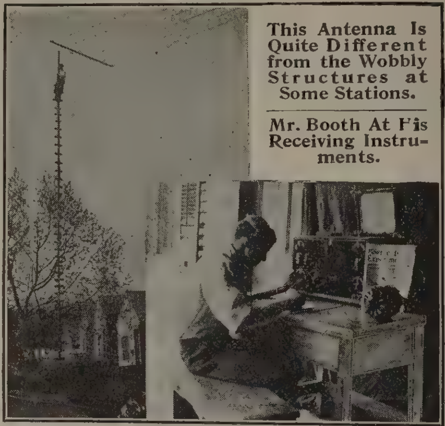
RADIO WAVES DEFLECTED BY MEXICAN ORE DEPOSITS.

Enormous ore deposits in the mountains of Northern Mexico have been responsible for much of the trouble experienced with the army wireless apparatus, according to the belief of army operators. They say that ore, acting possibly as a solid sheet of metal, deflects the radio waves, thus weakening the capacity of both the sending and receiving stations.

The field telegraph line, which does not reach the advanced base by about fifty miles, has been practically useless because of the frequency with which it has been cut.

DANIEL M. BOOTH'S WIRELESS OUTFIT.

The set pictured here is made and constructed after my own ideas. It contains a loose coupler, two variable condensers, one fixed condenser, detector and buzzer. The taps above my left hand enable me to switch one of the variable condensers across the aerial and ground, put it in series with the aerial or cut it out altogether. The aerial pole is 55 ft. high. The aerial has six wires, 100 ft. long. The set was not photographed in the station on account of poor light. THE ELECTRICAL EXPERIMENTER has given me many ideas in building it and is a magazine that every amateur can have in his station on account of the low price. My set is capable of receiving NAA, NAR and many others.



This Antenna Is Quite Different from the Wobbly Structures at Some Stations.

Mr. Booth At His Receiving Instruments.

DANIEL M. BOOTH.

Mobile, Ala.

C. J. ANDREW'S AMATEUR RADIO STATION.

The aerial, 65 feet long and 53 feet high, is of the inverted "L" loop type, and is very efficient. The receiving cabinet consists of two receiving transformers, one circular and one oval; three galena detectors, E. I. Co. loading inductance, E. I. Co., Jr., fixed condenser, rotary variable condenser of my own make, intermediate 20-point loader, and a loading coil, which is hooked in series with E. I. Co.'s, allowing the use of either coil separately or both at once. These instruments are used in conjunction with a pair of 2,000 ohm 'phones. By using 3,000 ohm 'phones I get N A R, but I can get N A A with most anything. The sending set is of the 1-inch coil variety, with a glass plate condenser and helix to match. An aerial switch, key and 100 ampere-hour storage cell complete the set. I am a member of the R. L. of A., as you will notice by the certificate.

Mr. Andrew's Set Is a Good Example of the Trend Toward Case Sets in Amateur Stations.

THE ELECTRICAL EXPERIMENTER is a regular and welcome visitor to 8 U B, and I can say without exaggeration that in my opinion it is the very best experimenters' magazine in existence.

C. J. ANDREWS.

Pittsford, Mich.

WHAT MAKES A SUCCESSFUL ENGINEER?

There are six groups of factors which are essential to the successful engineer, according to a preliminary investigation made by the Carnegie Foundation for the Advancement of Teaching, New York City, as follows: 1. Character, covering integrity, responsibility, resourcefulness and initiative. 2. Judgment, covering common sense, scientific attitude and perspective; 3. Efficiency, covering thoroughness, accuracy and industry; 4. Understanding of men, including executive ability; 5. Knowledge of the fundamentals of engineering science, and 6. Technique of practice and of business.

PETER J. PRINZ AND JOSEPH TURLIF, RADIO ENTHUSIASTS.

Our wireless set comprises a large home-made loose coupler, a coupled loading coil, two variable condensers, an audion and a pair of E. I. Co. and Murdock 2,000 ohm 'phones. The aerial is 150 feet long and 70 feet high. For transmitting we use only a 1" spark coil not shown in the picture.

In the winter we have heard Darien, Colon, Key West and several other distant southern stations. We also receive from Sayville, Tuckerton and Arlington. We are now using a special oscillating hook-up for receiving undamped waves.

Here Are Four Operators Who Can Copy Darien and Colon from New York.

We shall be glad to hear from anyone within our sending range—call 2 APP. All of our apparatus is home-made except the audion, 'phones and spark coil.

Jamaica, N.Y. PETER J. PRINZ.

RADIO LABORATORY OF G. C. SABIN.

This radio station handles practically all message work for points east and west, including the bulk of Boston business for south and west and all other points within 900 to 1200 miles from this city. 1ZL—owned and operated by Mr. Lewis and myself—handled 203 messages from April first to fourteenth inclusive.

Excellent Radio Station of G. C. Sabin.

Mr. D. A. Lewis is now attending the University of Michigan and Mr. H. J. Murphy is my assistant. We use a Packard transformer, oil immersed condenser, with copper foil on 11x14 photo plates, two sections in series-parallel, and a rotary quenched gap of our own construction, of which there are only two in existence to our knowledge. The single audion is used for all our work and the second one as a spare only. We work 9PC practically every night and nearly all "eight" stations who have over a half kilowatt rating.

G. C. SABIN.

Northampton, Mass.

NEW RESEARCH LAB. AT MASS. IN'ST. TECHNOLOGY.

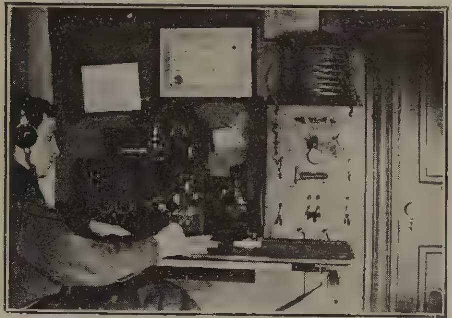
The new electrical research laboratory at the Massachusetts Institute of Technology, Cambridge, Mass., will be situated under the central dome and in the east extension. Its equipment will include the finest collection of artificial electric conduction lines in the world. There will be a 2,000-nautical mile artificial submarine cable, corresponding in character to usual under-water telegraph cables, a 2,500-mile long-distance aerial telephone line, a 35-mile artificial telephone submarine line and two artificial power transmission lines 800 miles in length. The laboratory will have a number of measuring devices of unusual type, and a large amount of specially built research apparatus.

RADIO SET OF SARGEANT E. C. WAIDLER.

A photo of my old station appeared in your August, 1915 issue. The station that I have now was built from suggestions and ideas published in your magazine and by referring to my old station you can see how well I came out.

Here is a description of my receiving station: loose coupler of 2,000 meter wave length, mounted in lower cabinet, with ten taps on secondary controlled by a switch, The right secondary has thirty-eight taps controlled by two switches on left of cabinet. A Murdock loading coil of 4,000 meters is included, also variable and two fixed condensers for the detector circuit, and an audion for long distance, mounted on top of the cabinet. For local work I use a Ferron or a Halcun detector, mounted on the lower cabinet. For sending there is a ½ k.w. transformer and an air-cooled gap. The marble switchboard and helix are home-made. The aerial consists of four phosphor bronze, stranded cables, each 90 feet long, elevated 12 feet and 75 feet above the ground at the two masts.

I hear NAA every evening. In the daytime I also hear NAR, NAX, NAS and NAY, which I think is *some record* for a station of this size. I received my *Radio League of America* membership certificate and button and think they are dandy. They may be seen hanging in the center of the picture. I think your magazine is excellent and can hardly wait a month for it.



Fine Wireless Transmitting and Receiving Set of S. E. C. Waidler.

SARGEANT E. C. WAIDLER.

E. Toledo, Ohio.

Amateur News

The Mahoning Valley Radio League is Organized.

The Mahoning Valley Radio League with headquarters at Niles, Ohio, was organized with a charter membership of twelve on January 23, 1916. The following members were elected: President, Charles Thompson; vice-president, David Jenkins; secretary and treasurer, Luther Kovalik.

As soon as the club becomes financially able it expects to get club rooms and a 1 K.W. transmitting outfit with a supersensitive receiving set.

There are two classes of members, student and full members. The entrance fee for the former is fifty cents and for the latter $1.00. We extend our invitation to any amateur in the territory who wishes to join. Address the secretary, Luther Kovalik, 322 Hunter Street, Niles, Ohio.

Oklahoma Radio Experimental Association.

The Oklahoma Radio Experimental Association was recently organized for the purpose of developing wireless telegraphy and telephony in the State of Oklahoma. The following are officers for the coming year: Adolph Walton, president; Donald Danvers, vice-president; Clifford A. Smith, secretary-treasurer, and Keith Danvers, business manager. We would like to hear from all amateurs in the State regarding the range of their stations so that we may communicate with them by wireless. Address all communications to the secretary at 922½ W. Main St., Oklahoma City, Okla.

The San Francisco Radio Club.

The San Francisco Radio Club is a comparatively new organization, but the club has twenty-five members, with promises of as many more prospective members.

This being the only amateur radio club in San Francisco, it has grown with great rapidity, and has a bright future.

The following officers now hold office: President, A. W. Martin, Jr.; Vice-President, Frank Taylor; Secretary, William Griffith; Corresponding Secretary, Thomas Ryan; Sergeant-at-Arms, Coma Altland.

All correspondence should be addressed to the Corresponding Secretary, Thomas Ryan, 82 Downeyis St., San Francisco, Cal.

Beverly, Mass., Amateurs.

Twenty-eight members of the Essex County Amateur Wireless Association of Beverly, Mass., attended a recent meeting of the association, held at the High School building.

Ralph Hersey, of Salem, president of the association, presided. The feature of the evening was a talk by F. Clifford Estey, of Salem, one of the pioneers in wireless in the county and who for years had one of the best amateur stations in the country. He is now a member of the Institute of Radio Engineers and of other wireless organizations. He gave much encouragement to the members of the association and told them of some of the difficulties he had encountered when wireless was new. He promised to co-operate with the association and urged the members to interest all county amateurs in the organization.

It was arranged that Sherman Lynch, of Abbott street, should send out every night at 7 o'clock the Government time from his wireless station, as well as the weather report.

Little Falls, N. Y., Radio Club.

On Jan. 28, 1916, the Little Falls (N. Y.) Radio Club was organized at the Y. M. C. A. building with the following officers elected: Clifford McDonald, president; Earl Rhodes, vice-president; Albert Hayes, secretary; Leland Van Allen, assistant secretary; Franklin Dillenbeck, treasurer, and Allen Levee, chief operator. The other charter members are: Raymond Neely, Fred Ashenhurst, Lester Las Sell, Russel Hall, Paul McDonald and Ernest Chandler.

At the first meeting, general organization was the main feature and several questions as to the future were decided upon. The financial problem was the most serious question, and after many propositions a means of obtaining revenue other than through the weekly dues was decided upon. As soon as the required amount is obtained the construction of a high-powered station under the supervision of the chief operator, Allen Levee, will be duly installed.

The club will be pleased to hear from other radio clubs and all communications should be addressed to The Little Falls Radio Club, care Y. M. C. A., Little Falls, N. Y.

RADIO CLUBS ATTENTION!

We are always pleased to hear from young Edisons and Radio Clubs. Send a write-up of your Club with photos of members and apparatus to-day to: Editor "Amateur Gossip" Section, The Electrical Experimenter, 233 Fulton St., New York City.

Graceland Wireless Club of Lamoni, Iowa.

The Graceland Wireless Club has been carrying on active work. The club station is of the most modern type, the transmitter comprising 1 kw. transformer and the receiving set a Navy type tuning apparatus and De Forest Audion with multi-audi-fone amplifier equipment. The 100 foot self-supporting tower for the antenna is under process of erection. Members of the club consist of Graceland College students and high school students. The officers for the present year are as follows: President, Arthur B. Church; Vice-President, Dean Wight; Secretary, Jesse Roth. Address all communications to Arthur B. Church, Lamoni, Iowa.

The Gloversville Wireless Association.

Several months ago the Gloversville Wireless Association was organized with the following officers: Leonard Edick, president; Carl Rossback, vice-president; Raymond Baker, secretary. The following are members: William Vickery, Gerald Lucas, Blakely Cross, Harold Gibbons, Louis Krieg and Floyd Oathout.

Meetings are held every week at the members' houses. Papers on wireless and electrical matters are read by the advanced members. The members, divided into two teams under the leadership of Blakely Cross and Raymond Baker, set about making portable sets. Quite a little field work was done before the club organized.

Those interested should communicate with Raymond Baker, 39 Steel avenue, Gloversville, N. Y.

The Inter-City Radio Association.

The Inter-City Radio Association of Allentown, Pa., was organized last November. Meetings are held every Tuesday night. All the members are equipped with complete stations. The future of the club seems to be promising. The officers are: John Bernhard, president; William J. Kreis, secretary; John R. Schall, solicitor; David H. Goodling, association inspector.

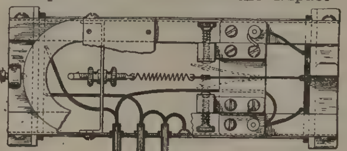
All communications concerning this organization should be addressed to the secretary, William J. Kreis, 623 North Penn street, Allentown, Pa.

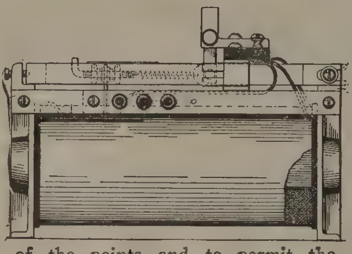
LATEST PATENTS

Vibrating A.C. to D.C. Rectifier.

(No. 1,179,515; issued to Lester E. France.)

This vibrating rectifier utilizes both halves of the cycle and secures sparkless operation of the contact points when supplying uni-directional current to a receiving circuit which may or may not have counter E.M.F., by providing means whereby the points shall not make or break contact until the voltage of the charging wave equals at least the voltage of the receiving circuit, when there will be no difference of potential between the points, and consequently no sparking. Means are provided to cushion the impact of the points and to permit the points to move together or with each other, as during the peak of the wave. The instrument automatically opens the charging circuit so that the battery cannot discharge, if for any reason the rectifier should cease operating. Also it will not pass reversed current into the battery. It employs a permanent magnet and a compound electromagnet to affect these results.

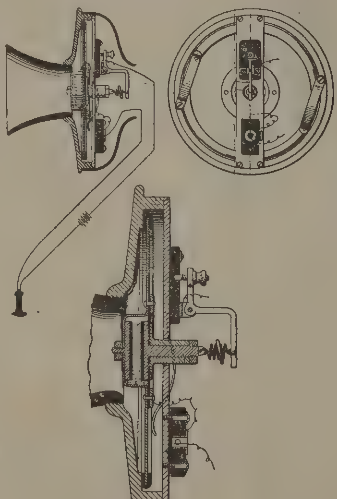


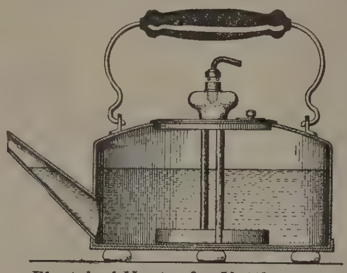


Balanced Telephone Transmitter.

(No. 1,176,725; issued to Edward H. Amet.)

The inventor has here provided an electrical transmitter in which the actuating diaphragm cannot change the fixed operative adjustment between the electrodes of the variable electrical resistance. It has a tension device placing the diaphragm under spring tension and applied so as to draw apart or separate the electrodes and whereby the electrodes are made to form a part of a spring balance. Thus they form a sensitive device for indicating the intensity of the sound wave impulses received upon the transmitter diaphragm and produce upon the variable electrical resistance material the proper action and reaction for regulating an electric circuit in relative proportion to the sound wave impulses received upon the transmitter diaphragm, which is thus made to act as the pan of a sensitive spring scale.

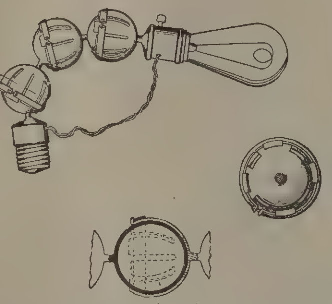




Electrical Heater for Kettles.

(No. 1,183,924; issued to William L. Waters.)

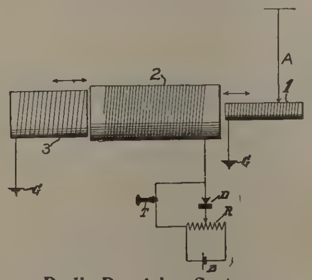
The object of this invention is to provide an electric heater supported from the lid or cover of the vessel and spaced therefrom, the heater being removable from the vessel with the lid or cover. The heater is preferably in the form of a spiral, in order to obtain a sufficient external heat-radiating surface. The heater is secured to, and spaced from, the cover of the vessel by means of a pair of hollow tubes which also serve as conduits for the wires carrying electrical energy to the heater.



Ball Joint Electric Light Bracket.

(No. 1,186,428; issued to Harold John Newman.)

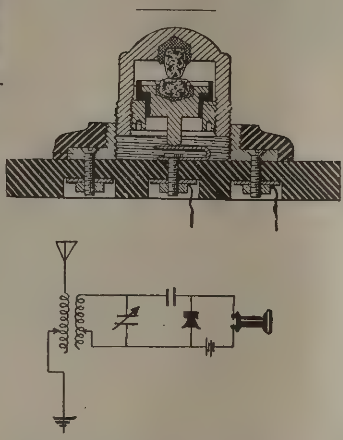
This invention relates to an adjustable lamp bracket, in which means are provided for increasing the frictional contact between the ball members and the socket members for taking up wear and insuring a tight fit between the members. The primary object of the invention is to construct a lamp bracket of members through the medium of which the lamp may assume a variety of positions irrespective of the connections between the lamp and the stationary support.



Radio Receiving System.

(No. 1,184,376; issued to Greenleaf Whittier Pickard.)

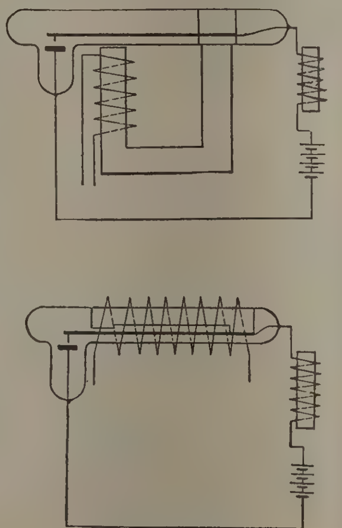
In the illustrations an inductance coil or receiving-coil 1 is connected between ground G and aerial or antenna A. A second or potential-raising coil 2 has connected to one of its ends the receiving apparatus comprising detector D, telephone T and potentiometer consisting of resistance R and battery B. The other end of this coil 2 is free. A third coil 3 may have one terminal connected to ground as shown, the other terminal being left free. The inventor says that better results are accomplished by thus dispensing with the closed or secondary circuit heretofore employed. In use, the operator adjusts the relations of coils 1, 2 and 3, and the detector D and potentiometer R, B until he obtains the best results, as indicated by telephone T, from any given transmission. No adjustment of the inductances of coils 2 and 3 is needed.



Wireless Telegraph Detector.

(No. 1,182,946; issued to Ross G. Vosburgh.)

Improved form of radio detector utilizing two rectifying minerals, carborundum and ferro-silicon, substantially mounted in a dust-proof container. This combination is claimed to be very sturdy and not easily knocked out of adjustment by mechanical jars or antenna discharges, static, etc.



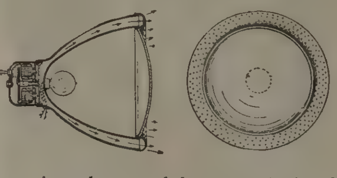
Electrical Relay.

(No. 1,185,240; issued to Aage Petersen, of Copenhagen, Denmark, assignor to Kemp & Lauritzen, of that city.)

In this relay the circuit-closing members are located in a closed chamber charged with helium or nitrogen, etc., gas which is so highly attenuated that it possesses an adequate electrical conductivity for the purpose of keeping the circuit or circuits, closed by the said members, completed for a certain time after the instant of contact of the vibrating circuit-closing members. The action is aided by a self-inductance coil in the circuit.

Combined Vehicle Lamp and Horn.

(No. 1,185,740; issued to Nathaniel B. Wales.)

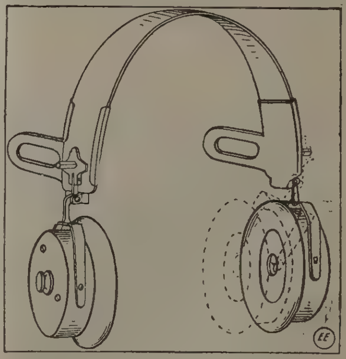


Auto lamp and horn are inclosed in a common casing of simple design without impairing the efficiency of either. The vibrating electric horn is placed back of the lamp, the sound issuing through the holes around the lens housing.

Head-Support for Radio 'Phones.

(No. 1,182,896; issued to Frank G. Davison.)

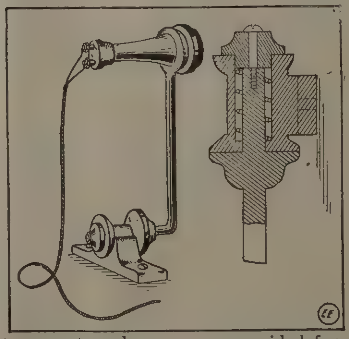
The object of the present invention is to provide improvements whereby the ear piece or receiver will be automatically locked in any position to which it is moved or shifted, relatively to the head piece, so that the ear piece or receiver may be held more or less firmly against the ear of the user, or swung outward as desired.



Telephone Receiver Support.

(No. 1,179,896; issued to Charles S. Cate.)

This invention comprises a supporting arm that is formed with a circular aperture or opening at its upper or outer end through which the telephone receiver is to be passed and supported during the conversation. The supporting arm is pivotally mounted on the base piece that is secured to any fixed support, and means are provided for frictionally retaining the arm in any desired position or adjustment. The device is designed to be secured to a fixed separate support, if desired.



COPIES OF ANY OF THE ABOVE PATENTS SUPPLIED AT 10c. EACH

Phoney Patents

Under this heading are published electrical or mechanical ideas which our clever inventors, for reasons best known to themselves, have as yet not patented. We furthermore call attention to our celebrated Phoney Patent Offizz for the relief of all suffering daffy inventors in this country as well as for the entire universe.

We are revolutionizing the Patent business and OFFER YOU THREE DOLLARS ($3.00) FOR THE BEST PATENT. If you take your Phoney Patent to Washington, they charge you $20.00 for the initial fee and then you haven't a smell of the Patent yet. After they have allowed the Patent, you must pay another $20.00 as a final fee. That's $40.00 ! ! WE PAY YOU $3.00 and grant you a Phoney Patent in the bargain, so you save $43.00 !! When sending in your Phoney Patent application, be sure that it is as daffy as a lovesick bat. The daffier, the better. Simple sketches and a short description will help our staff of Phoney Patent examiners to issue a Phoney Patent on your invention in a jiffy.

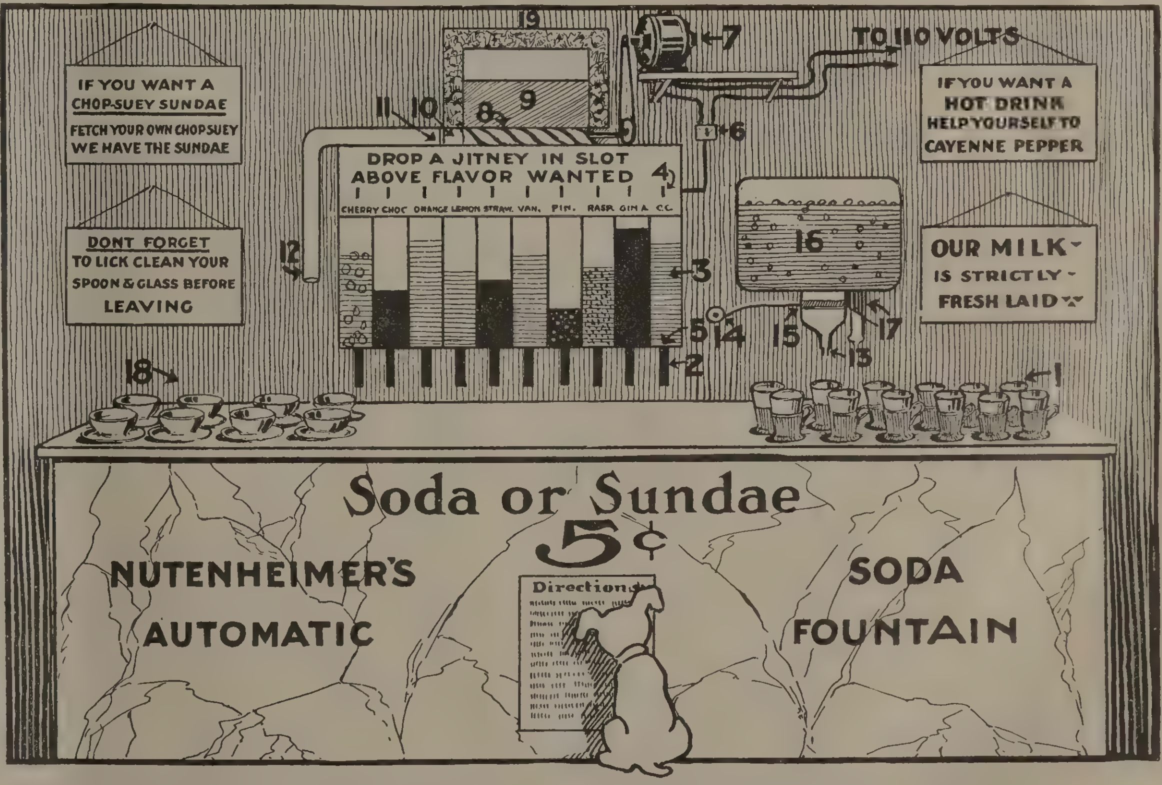
PHONEY PATENT OFFIZZ

A. FIZZ SWABBER, OF NUTMAPLECREAM, S. D.
MECHANICAL SODA DISPENSERATOR

No. H_2SO_4 **Specifications Fully Charged** **Patented Sundae the 5¢**

To Whom It May Condole:

Be it known, that I, A. Fizz Swabber of the city of Nutmaplecream, Nutty County, in the state of Slow Decay, have promulgated, invented and outvented an automatic soda fountain of the automat type. The main and immediate purpose of my invention is to do away entirely with all soda-counter clerks and fizz-bartenders. I thereby save the entire working salary of these unsanitary bromide mixers as well as saving a long-suffering public from germ diseases occasioned by said syrup-slingers' unsanitary fingers exploring innocent soda glasses and sundae dishes.



Here's the Latest in an Automatic "Jitney" Phizz-water Dispenserator. Every Flavor Has a Meaning All Its Own.

Another object of my invention is to fashion the soda glasses, 1, as well as the sundae dishes 18, of a hard but thin biscuit dough similar to that used in the common ice cream cones. Thus these receptacles do not have to be cleansed or washed but can be drunk right with the soda or sundae. I say "drunk" purposely, for the reason that the dough becomes soft and mushy after about 19 seconds and if not gulped down quickly the contents of the "glass" will spurt over the customer.

This, however, is not a disadvantage. Quite to the contrary, notwithstanding, it is a great tactical advantage of considerable harmonious importance as will be illuminantly obvious from the following:

It is a well known fact supported by much rhetorical evidence, that on a hot day it is next to impossible to get next to a soda counter. This is by no means due to a big thirst rush. Statistics on the subject prove that 98 7/16% of the customers hang about the fountain for an average of 18 72/89 minutes each. If the fountain can accommodate but 10 people it means that it takes almost 19 minutes before the next ten will be accommodated. Now, manifestly, it does not take 19 minutes to drink a soda or to eat on a Monday a sundae. Where then is the time loss? In gassing and gabbing on the part of the customers, or otherwise by their loafing and watching the white (?) clothed soda-contortionist. My novel soda glass which can be drunk or rather MUST be drunk, does away with all this enormous time loss, cutting each customer's soda time from 19 minutes down to 19 seconds, a saving of 5,655% in time alone. He simply can't stay longer than 19 seconds unless he wears a bathing suit and doesn't care for the certain soda shower bath.

From this is becomes apparent that even on a hot day business will run smooth as clockwork and there will not be any undue crush. Even when the counter is lined three deep, the third man can figure the time accurately which it will take him to reach the first line trench, in other words his waiting time will be 3x19=57 seconds.

The "modus operandi" is as follows:

First insert jitney in slot. After the automat pours the incandescent flavoring (3) from spout (2) into eatable "glass" 1 the victim places the "glass" under spout 12. As the jitney oscillates through the machine, it impinges on switch 6 which starts motor 7, causing endless spiral 8 to revolve. Ice cream 9 is forced from the depository 19 into the hexagonal receptacle 10 until it is full. This stops the motor and allows the ice cream to pass trap 11 and down into the "glass."

The third step for the customer is to place the "glass" beneath spout 13, and turn switch 14 whereupon valve 15 allows 4½ cubic centimeters of phizzwater to gush forth. As the valve closes, trigger 17 permits a straw to shoot down into the "glass." After gulping down the drink plus "glass" in a single swallow, the soda fiend carefully licks off the spoon and dries it on his trousers. In case of a "she," the powder puff will do excellent service.

What I claim is:

1. A device which will dispense a better drink quicker, without the help of an unsanitary clerk, than the best drug store in the Sahara Desert.
2. A time-saving express soda swallower device which will cut down the swallowing time to 19 seconds eastern time.
3. A sanitary soda and sundae dispenser, dispensing with glass glasses, substituting therefor drinkable non-glass glasses.

In testimony whereof, I put my zeal this 38th Dog day in the City of Nutmaplecream.

(Signed) A. FIZZ SWABBER,
By his attorney,
Francis Crump.

Witnesses:
Watcha Have,
I. Screamsody,
Geta Nutfosfate.

OFFICIAL LIST OF LICENSED RADIO AMATEURS NOT TO APPEAR IN ANNUAL GOVERNMENT CALL BOOK, UNTIL SEPTEMBER, 1916.

Amateur Radio Stations Licensed by the Bureau of Navigation During the Month of January, 1916. (Continued.)

SECOND DISTRICT—(Cont'd.)

Call signal	Owner of station.	Location of station.	Power kilowatts.
2AIS	Dawson, Fred	64 Laurel Ave., Arlington, N. J.	.5
2AIA	Draper, George B.	1076 Anderson Ave., New York N. Y.	.5
2AIR	Eesbert, Hugo L.	682 Bergen St., Brooklyn, N. Y.	.5
2AHY	Everingham, Chas. E.	206 9th St., Troy, N. Y.	.5
2AIQ	Fink, Gustave	315 Lenox Rd., Brooklyn, N. Y.	.5
2AIM	Giefer, Frank H., Jr.	West Brighton, N. Y.	.5
2AIT	Gluck, John	1709 Park Ave., New York, N. Y.	.5
2AIP	Harper, Augustus E.	512 Washington Ave., B'klyn, N. Y	.5
2AIG	Havener, Osborn F.	215 4th St., Newark, N. J.	.5
2IH	Hiller, Harry E.	5 Charles St., West Orange, N. J.	.5
2AIY	Johnson, John A.	1026 2d Ave., New York, N. Y.	.5
2AIK	Leek, Nathaniel L.	Amangansett, N. Y.	.5
2AHU	Littlefield, Chas. E.	2672 Mansfield Pl., Sheepshead Bay, N. Y.	.5
2AIV	Miller, Geo	Huntington Station, N. Y.	.5
2AIL	Mulcahy, Frank H.	444 E. 169th St., New York, N. Y.	.5
2AIN	Ostrewich, Thaddeus	116 Waverly Pl., New York, N. Y.	.5
2AIC	Pfaltz, Orlando R.	512 W. 122d St., New York, N. Y.	.5
2AIO	Pieri, Donald	Westchester and Bergen Ave., New York, N. Y.	1
2AJD	Redfern, Wm. W., Jr.	2249 82d St., Bensonhurst-by-the sea, N. Y.	.5
2AJH	Reed, Cecil J.	26 College Pl., Newark, N. J.	.5
2AJE	Rowley, Herbert G.	107 Clifton Ave., Newark, N. J.	.5
2AHT	Rupert, Stephen E. G.	107 2d St., Pelham, N. Y.	1
2AAM	Russo, Ernest O.	Atlantic City, N. J.	.5
2AIE	Scholz, Frank A.	251 New York Ave., Newark, N. J.	.5
2AIU	Scull, Walter	260 Fairmount Ave., Jersey City N. J.	.5
2XO	Tamburino, Anthony	1632 Parket St., New York, N. Y.	.5
2AKW	Thompson, Harold	21 Rose St., Paterson, N. J.	.5
2AJI	Willey, R. T.	1460 Bedford Ave., Brooklyn, N. Y.	.5
2AIJ	White, Clinton R.	484 Clinton Ave., Brooklyn, N. Y.	1

THIRD DISTRICT.

Call signal	Owner of station.	Location of station.	Power kilowatts.
3QN	Atlee, Charles B.	100 Linden Ave., Riverton, N. J.	.5
3MA	Bacon, Barry E.	1527 Girard Ave., Phila., Pa.	.5
3AKP	Bargelt, R. L.	Woodstock, Va.	.5
3AKG	Basford, Robert F.	112 W. 17th St., W ldwood, N. J.	.5
3RX	Buskey, Harry L.	425 Westover Ave., Norfolk, Va.	.5
3DE	Chism, Thomas A.	3617 O St., N.W., Wahsington, D. C	.5
3AKK	Dolbow, Geo. W.	215 W. 22d St., Wilmington, Del.	.5
3AKI	Eisenhard, Stanley E.	1512 Gordon St., Allentown, Pa.	1
3AKT	Eisenhauer, Harry D.	744 N. 11th St., Reading, Pa.	.5
3AKM	Goldstein, Wm.	642 N. Clinton Ave. Trenton N. J.	.5
3HC	Green Daniel J.	610 Sashington St., Cape May, N. J.	.5
3AKH	Greenfi ld, Robert H.	1626 W. Ontario St., Phila., Pa.	.5
3PR	Hamburg, Russell	105 E. Crocus Rd., Wildwood Crest, N J.	.5
3LM	Herandez, Roger B.	1326 Chew St., Allentown, Pa.	.5
33AAK	Hopkins, Jas. R.	3214 West Ave., Newport News, Va.	.5
3AAK	Hopkins, Jas. R.	3214 West Ave., Newport News, Va.	.5
3AKN	Lewis, Max J.	222 Jackson At., Trenton, N. J.	.5
3QO	McCloskey, J. Leonard	112 Broad St., Palmyra, N. J.	.5
3MR	Mandelkern, Maurice H.	2349 N. 15th St., Phila., Pa.	.5
3OK	Paine, Jas. P.	525 South St., Portsmouth, Va.	.5
3AKR	Phillips, Raymond B.	400 W. 24th St., Wilmington, Del.	.5
3QI	Poole, Geo. D.	2804 Chestnut Ave., Newport News Va.	.5
3ADP	Reed, Richard M.	716 Main St., Riverton, N. J	.5
3AKW	Reid, J. Garnett	706 Edgwood Ave., Richmond, Va.	.5
3MQ	Ridgway, A. King	5 E. Melrose St., Chevy Chaw, Md.	.5
3LL	Schaff, Merle S.	Riverton, N. J.	.5
3BD	Smith, Alan P., 3d	18 E. Madison St., Baltimore, Md.	.5
3AKS	Smith, Harry F.	247 E. Ross St., Lancaster, Pa.	1
3HU	Walton, Brewer G.	1420 N. Bouvier St., Phila., Pa.	.5
3BV	Watson, Paul G.	214 W. Barnard St., West Chester, Pa.	.5
3ADP	We gel, Geo. H.	716 Main St., Riverton N. J	.5
3AKO	Wilson, Roy	30th & Locust St., Wilmington, Del.	.5
3AKF	Young Men's Chris. Ass'n.	1421 Arch St., Philadelphia, Pa.	.5

FOURTH DISTRICT.

Call signal	Owner of station.	Location of station.	Power kilowatts.
4DH	Church, Archie W.	196 Chapel St., Atlanta, Ga.	1
4DD	Emory University	Oxford, Ga.	1
4DG	Hawkins, Marion	14 Richmond Ave., Atlanta, Ga.	1
4DF	Johnstone, Henry P.	106 S. Edison Ave., Tampa, Fla.	.5
4DI	Rothrock, Wm. S.	517 Ridge Ave., Winston-Salem, N. C.	1
4BG	Watkins, C. E.	Fort Pierce, Fla.	1

FIFTH DISTRICT.

Call signal	Owner of station.	Location of station.	Power kilowatts.
5AF	Berger, Carl G. F.	217 E. Commerce St., Altus, Okla.	.5
5BP	Butcher, Cecil F.	423 W. 12th St., Dallas, Tex.	.5
5AK	Craven, Wm. M.	1516 S. 12th Ave., Birmingham, Ala	1
5BB	Greenlaw, Paul E.	Franklinton, La.	.5
5AY	Hall, Henry	Beevile, Tex.	.5
5AI	Jones, Burle R.	1103 Gibson St., Muskogee, Okla.	.5
5BX	Martin, George W.	209 S. Edgefield Ave., Dallas, Tex.	1
5AN	Milam, Monroe W.	603 N. 4th St., Waco, Tex.	.5
5BG	Parkes, Thos. F.	2411 Kensington St., Nashville, Tenn.	.5
5BT	Selby, Clarence M.	1163 Locust St., Muskogee, Okla.	.5
5AX	Simmons, Dorr R.	528 Merrick St., Shreveport, La.	1
5BE	Tonahill, Maurice	714 S. 8th St., Waco, Tex.	.5

SIXTH DISTRICT.

Call signal	Owner of station.	Location of station.	Power kilowatts.
6PG	Spatafore, Joseph	453-AFilbert St., San Francisco, Cal	.5

SEVENTH DISTRICT.

Call signal	Owner of station.	Location of station.	Power kilowatts.
7KJ	Armstead, Jas. H.	112 E. 6th St., Aberdeen, Wash.	1
7IS	Barrett Geo. G.	1200 9th Ave., Lewiston, Idaho	1
7DN	Engholm, Bernard	9 N. 9th Ave., North Yakima, Wash.	1
7GR	Gratke, Chas. E.	517 Grand Ave., Astoria, Oreg.	.5
7HO	Hawkins, Ernest P.	556 Grand Ave., Astoria, Oreg.	.5
7FN	Holloway, Wm. L., Jr.	428 Hemlock St., Helena, Mont.	.5
7RK	Kertson, Ross J.	322½ E. 28th St., Portland, Oreg.	.5
7MF	Miller, Geo. F.	1005 E. Division Lane, Tacoma Wash.	1
7MW	Mitchell, Walter L.	3613 Densmore Ave., Seattle, Wash.	.5
7OA	O'Connor, Wm.	1029 E. Clakkamas St., Portland, Oreg.	.5
7HR	Reichert, Howard G.	1014 E. 30th St., Tacoma, Wash.	1
7JN	Richards, John, Jr.	143 Matte St., Meade ville, Mont.	.5
7GE	Spencer Guy E.	446 6th St., Portland, Oreg.	.5
7MS	Steensen, Mark D. S.	206 N. Nachez Ave., N. Takima, Wash.	.5
7SF	Stoner, Lloyd E.	R. F. D. No. 1, Astoria, Oreg.	.5
7SW	Swan, Emil	146 Portsmouth Ave., Portland, Oreg.	1
7RH	Teeson, Robert	Camas, Wash.	.5
7PG	Truesdell, Herbert M.	2730 E. 53d St., Seattle, Wash.	.5

EIGHTH DISTRICT.

Call signal	Owner of station.	Location of station.	Power kilowatts.
8ANO	Baisley, J. Everett	32 George St., Wyandotte, Mich.	.5
8AT	Barton, Howard	3 Clay St., Le Roy, N. Y.	1
8CF	Beller, Harold F.	731 W. Mars St., Bucyrus, Ohio.	.5
8ANR	Benson, Walfred	16 Central St., Battle Creek, Mich.	1
8ANW	Brown, Le Roy	R. F. D. No. 8, Hamilton, O.	.5
8ANJ	Burgoon, Wesley	604 N. Baxter St., Lima, O.	.5
8CT	Bush, Calude M.	R. F. D. No. 44, Weedsport, N. Y.	.5
8ANY	Carpenter, Donald F.	65 Union St., Wilkesbarre, Pa.	1
8PV	Jackson Co., The C. F.	Findlay, Ohio.	1
8AMD	Craig, Palmer	3397 Glenmore Ave., Cincinnati, O.	.5
8ANK	Ernest, Robert A.	1815 Prospect St., Springfield, O.	.5
8ANP	Exline, Geo. A.	1408 E. 93d St., Cleveland, O.	1
8ANS	Foltz, Harold H.	454 Rhodes Ave., Akron, Ohio.	.5
8ANV	Glause, Edwin H.	2171 E. 65th St., Cleveland, O.	.5
8IW	Green, John W.	Booth t., Ashtabula, O.	.5
8UW	Gregory, P. L	220⅝ Washington St., Conneatu, O.	.5
8ANM	Griggs, Kenneth C.	149 Forest St., Wellington, O.	.5
8BD	Kimberley, Frank	1402 Monterey St., Pittsburgh ,Pa.	.5
8UT	Hirsh, Leo E.	1281 S. High St., Columbus, O.	.5
8ANU	Jensen, Luther J.	606 Parkside Ave., Buffalo, N. Y.	.5
8CR	Johnson, J. H. E.	349 Glenn Ave., Springfield, Ohio.	.5
8DK	Kobro, Frank	7711 Central Ave., Cleveland, O.	.5
8ANL	Leppert, John L.	611 E. Church St., Galion, O.	.5
8UI	Lester, Wm. G.	189 N. Division St., Buffalo, N. Y.	.5
8ANQ	Lewis, Nelson	2921 Urviler St., Cincinnati, Ohio.	.5
8CS	Pardridge, Walter T.	3039 Washington Ave., Saginaw, Mich.	1
8VA	Pearce, Henry A.	223 Cedar St., Buffalo, N. Y.	.5
8ANX	Phillips, Wm. M.	77 Market St., Mt. Clemens, Mich.	.5
8GJ	Piper, Floyd B.	142 Breckenridge St., Buffalo, N. Y.	.5
8NT	Proffit, Jerome B.	471 Lincoln Ave., Bridgeport, O.	1
8AP	Reich, Herbert	11423 Asbury Ave., Cleveland, O.	1
8IH	Ross, Donald H.	375 Commonwealth Ave., Detroit Mich.	.5
8ANT	Slyfield, Chas. O.	Frankfort, Mich.	1
8ANN	Somers, Warren A.	151 E. Main St., Bradford, Pa.	1
8RP	Suterland, Arthur E., Jr.	105 Bellevue Drive, Rochester, N. Y.	.5
8BZ	Turnbull, Alonzo E.	1167 Lagonda Ave., Springfield, O.	1
8ACI	Waller, Nellie M.	615 N. 4th St., Cambridge, O.	.5
8VT	Weaver, Henry C.	1002 Bellaire Ave., Pittsburgh, Pa.	.5
8JT	Williams, Raymond K.	1342 Westlake Ave., Lakewood, O.	.5
8BS	Swan, Donald	123 Canfield Ave., Detroit, Mich.	.5

NINTH DISTRICT

Call signal	Owner of station.	Location of station.	Power kilowatts.
9BT	Baldwin, Edward F.	623 Crawford Ave., Dixon, Ill.	.5
9WY	Barnickol, Carl R.	2317 Milwaukee Ave., Chicago, Ill.	.5
9AAR	Barton, Harold D.	20 W. 26th St., Indianapolis, Ind.	.5
9WZ	Blue River Power Co.	Crete, Nebr.	1
9AAI	Bruestle, Walter F., Jr.	22 Sterrett Ave., Covington, Ky.	.5
9IQ	Burr, Ralph H.	2029 5th St., Boulder, Colo.	.5
9AAG	Butler, Leonard	Wheaton, Ill.	.5
9AAC	Carlisle, Lloyd	716 N. Broadway, Crookston, Minn	1
9AAM	Clough, Kendall	2215 S. Royce St., Sioux City, Iowa.	.5
9IW	Dennis, Eben R.	Hutchinson, Minn.	1
9AAP	Dunlap, Carroll M.	High School, Manchester, Iowa.	.5
9AAC	Ebert, Arthur	2320 Potomac Ave., Chicago, Ill.	1
9JD	Jorgenson, O. B.	1619 Hughitt Ave., Superior, Wis.	.5
9AAK	Knowles, Ivar A.	523 Merchant St., Effingham, Ill.	.5
9WX	Kramer, Andrew	7724 Lowe Ave., Chicago, Ill.	1
9IJ	Lloyd, Norman W.	2658 W. 39th Pl., Chicago, Ill.	1
9IN	Locke, Melvin W.	Independence, Iowa.	1
9AAJ	Mathison, Michael C.	Glen Ellyn, Ill.	.5
9AAH	Neidlinger, Laurence C.	3322 Northwestern Ave., Indianapolis, Ind.	.5
9AAL	Newlin, Myron	2712 Indianapolis Ave., Indianapolis, Ind.	.5
9AAF	Oonk, Wm. J.	2232-A Red Bud Ave., St. Louis, Mo.	.5
9AAN	Pecha, J. D.	2331 S. Avers Ave., Chicago, Ill.	.5
9BQ	Rhea, Robin E.	Indianola Rd., Des Moines, Iowa.	1
9AAE	Russell, Wolfert E.	5701 Clemens Ave., St. Louis, Mo.	.5
9AAS	Shockey, Clarence A.	Cameron, Mo.	.5
9AAQ	Simpson, Virgil S.	1380 Union Ave., St. Louis, Mo.	.5
9IY	Singleton, Paul G.	3161 Kenwood, Ave., Indianapolis, Ind.	.5
9AAD	Slentz, Daniel R.	305 Douglas St., Fort Wayne, Ind.	.5
9WW	Smith, Raymond L.	3005 Fulton St., Chicago, Ill.	
9HX	Stewart, Lawrence W.	211 Hicks Ave., Columbia, Mo.	1
9OR	Thomas, Martin N.	3019 Locust St., St. Joseph, Mo.	.5
9AAB	West, Paul H.	631 Harrison St., Gary, Ind.	1
9KE	Wilcox, Chas. W.	427 S. Brighton St., Kansas City, Mo.	.5

Amateur Radio Stations Licensed by the Bureau of Navigation During the Month of February, 1915.

FIRST DISTRICT.

Call signal	Owner of station.	Location of station.	Power kilowatts.
1EAI	Abels, Charles A	43 Nicollet St., Lowell, Mass.	.5
1OA	Anthony, Richard L.	336 College St., Lewiston, Me.	.5
1ANX	Bailey, Willard L.	52 Robins Rd., Arlington, Mass.	.5
1ATJ	Black, Oliver M.	19 Charles St., Lawrence, Mass.	.5
1ATW	Brogan, Arthur R. J.	12 Grigg St., Greenwich, Conn.	1
1ASU	Brown, Irving M.	269 Northrup St., Providence, R. I.	.5
1ATG	Carleton, Francis J.	34 Concord St., Charlestown, Mass.	.5
1ASN	Clark, Wesley C.	High School, Arlington, Mass. (has 2 stations)	.5

(*Continued on opposite page*)

OFFICIAL LIST OF LICENSED RADIO AMATEURS NOT TO APPEAR IN ANNUAL GOVERNMENT CALL BOOK, UNTIL SEPTEMBER, 1916.

Amateur Radio Stations Licensed by the Bureau of Navigation During the Month of February, 1916. (Continued.)

FIRST DISTRICT—(Cont'd.)

Call signal	Owner of station.	Location of station.	Power kilowatts.
1ASK	Coggins, Paul P.	93 Homer St., Newton Center, Mass.	.5
1ASL	Davis, Emery W.	1045 Beacon St., Newton Highlands, Mass.	.5
1ATO	Davis, Everett E.	16 St. Lawrence St., Portland, Me.	.5
1ASX	Davis, Harold W.	R. F. D. No. 2, Keene, N. H.	.5
1LY	Daykin, Leo H.	339 Beacon St., Somerville, Mass.	.5
1ATX	Dean, Reginald L.	23 Grove Ave., Westerly, R. I.	.5
1LE	Dean, Samuel W.	Quincy St., Cambridge, Mass.	.5
1ATK	Dieter, Dean C.	216 Lynn Fells Way, Melrose, Mass.	.5
1ATI	Drake, Nathan L.	303 Mt. Auburn St., Watertown, Mass.	.5
1ATT	Draus, William L.	13 Fountain Ave., Somerville, Mass.	.5
1ATB	Dunham, Carroll S.	Berlin, Conn.	.5
1ATF	Ferguson, Arthur W.	52 Linden St., Everett, Mass.	.5
1EAA	Gavin, Thomas H.	49 Lyon St., Fall River, Mass.	.5
1ASJ	Harris, Nathan G.	94 Hudson St., Hartford, Conn.	.5
1ATP	Hatfield, Samuel J.	80 Pleasant St., Arlington, Mass.	.5
1ASZ	Hendrick, E. Allen	52 Warner St., Springfield, Mass.	.5
1LP	Hitchcock, Richard C.	11 Waller Court, New London, Conn.	.5
1ATY	Holcomb, Herbert A.	117 Spring St., Windsor Locks, Conn.	.5
1ATH	Hunt, Alfred W.	137-A Belmont St., Everett, Mass.	.5
1ASB	Huston, Robert D.	19 Nevens St., Portland, Me.	.5
1ABX	Hutchins, Albert G., Jr.	42 Illinois St., Central Falls, R. I.	.5
1ANP	Hyde, Charles E.	11 Fearless Ave., Lynn, Mass	.5
1ASF	Jordan, Richard	22 Baldwin St., Cambridge, Mass.	.5
1ATA	Kempton, Ralph J.	Presque Isle, Me.	.5
1ASM	Koetter, Max W.	554 Broadway, Everett, Mass	.5
1ASW	Landick, Robert E.	77 Park St., Lynn, Mass.	.5
1ASR	Ludgate, Roswell V.	239 Broadway, Cambridge, Mass.	.5
1ATS	Macurdy, Ernest H.	28 Chester St., Watertown, Mass.	.5
1ASC	McKay, John S. R.	259 Pond St., Boston, Mass.	.5
1ASI	Merrow, Ernest W.	21 Houghton St., Worcester, Mass.	.5
1ATM	Meynell, Louis C.	49 Waban Hill Rd., Newton, Mass.	.5
1ATZ	Mitchell, Adolph H.	70 Jonathan St., Providence, R. I.	.5
1ANZ	O'Hara, John F.	66 Bassett St., Lynn, Mass.	.5
1PC	Palmer, Russell S.	93 Central St., Somerville, Mass.	.5
1ANQ	Palmquist, Walter N.	701 Cranston St., Providence, R. I.	.5
1EAB	Parker, Wesley G.	37 Cherry St., New Britain, Conn.	.5
1ATL	Peterson, Robert M.	3 Blodgett Pl., Worcester, Mass.	.5
1PN	Pettipas, William P.	14 Friend St. Pl., Lynn, Mass.	.5
1WB	Philbrook, Robert G.	Greenwood, Mass.	.5
1ATC	Pinkham, Everett C.	92 Franklin St., Watertown, Mass.	.5
1ASE	Poor, Stearns	100 Valentine St., West Newton, Mass.	.5
1ATN	Potter, Robert G.	50 Garfield St., Watertown, Mass.	.5
1ASQ	Quinn, Albert C.	14 Elsmere Ave., Lynn, Mass.	.5
1ANV	Reed, Parker C.	37 Norway St., Boston, Mass.	.5
1ANR	Rice, Alonzo H., Jr.	8 Thacher St., Hyde Park, Mass.	.5
1ATD	Ryan, James F.	51 E. Liberty St., Waterbury, Conn.	.5
1ASG	Scher, Harold C.	20 Ashton Ave., Beverly, Mass.	.5
1ASX	Sisson, Harry D., Jr.	41 Brenton Ter., Pittsfield, Mass.	.5
1ATQ	Spencer, Bonifield M.	17 Maple St., Attleboro, Mass.	.5
1AST	Spencer, Walter B.	41 Pleasant St., West Hartford, Conn.	.5
1GY	Stolba, Nestor W.	182 Lakeview Ave., Cambridge, Mass.	.5
1ASO	Surrette, Albert L.	434 Massachusetts Ave., Arlington, Mass.	.5
1ASV	Vose, Charles H.	1 Ocean Ter., Lynn, Mass.	.5
1ANW	Wadleigh, Paul F.	Hanover, N. H.	.5
1ATR	Walter, Wm. G.	53 Winthrop St., Everett, Mass.	.5
1LO	Weicker, Theodore, Jr.	79 Prospect St., Stamford, Conn.	.5
1ATV	Wood, E. Earl	Camden, Me.	.5
1ATE	Young, Bruce W.	23 Forest St., Arlington Heights, Mass.	.5

SECOND DISTRICT

Call signal	Owner of station.	Location of station.	Power kilowatts.
2AKZ	Anderson, Lansdell	226 Sylvania Ave., Avon-by-the-Sea, N. J.	.5
2ALG	Angen, John	1075 Elizabeth Ave., Elizabeth, N. J.	.5
2AKO	Burns, Raymond N.	203 Day 31st St., Bensonhurst, N. Y.	.5
2ALK	Capillon, Edward A.	799 Park Ave., New York, N. Y.	.5
2AKE	Cater, Raymond	Keyport, N. J.	.5
2AKJ	Caulfield, James V.	2331 185th St., New York, N. Y.	.5
2AJV	Cronin, Wm.	526 W. 174th St., New York, N. Y.	.5
2ALL	Dinga, Wm. E.	585 Amsterdam Ave., New York, N. Y.	.5
2ALI	Dunham, Nelson	103 1st Ave., Highland Park, N. J.	.5
2AKN	Eddy, John L., Jr.	11 3d Ave., New Brighton, N. Y.	.5
2ST	Emanuel, John H., Jr.	Englewood, N. J.	.5
2ALA	Francis, Sylvian	294 W. 92d St., New York, N. Y.	.5
2AJY	Goldstein, Jack	956 Stebbins Ave., New York, N. Y.	.5
2ALB	Gratzner, Raymond	802 W. 181st St., New York, N. Y.	.5
2AJP	Grummet, Melvin L.	9525 4th Ave., Brooklyn, N. Y.	.5
2AKM	Hanson, George V.	Rockaway Beach, N. Y.	.5
2AKV	Herbert, Normna	58 Crawford St., Newark, N. J.	.5
2AKU	Honeywell, Robert	515 Prospect Ave., Asbury Park, N. J.	.5
2AJL	Kalning, Wm. C.	1455 Ave. A., New York, N. Y.	.5
2AJB	Knies, Emil H.	274 W. 135th St., New York, N. Y.	.5
2AKR	Leighton, Leo	515 W. 172d St., New York, N. Y.	.5
2AKP	Lockard, J. F.	1 St. Nicholas Ter., New York, N.Y.	.5
2AJO	McKenna, John R.	134 Shonnard Ter., Yonkers, N. Y.	.5
2ALF	Manchee, Alleyne W.	745 Highland Ave., Newark, N. J.	.5
2AKL	Maran, Joseph F.	Marlboro, N. J.	.5
2ALC	Merrihew, John E., Jr.	Northport, N. Y.	.5
2AKD	Nichols, Robert W.	708 1st Ave., Asbury Park, N. J.	.5
2AKG	Olson, George I.	1348 Howard St., Peekskill, N. Y.	.5
2AJT	Reilly, Hugh	9808 Fort Hamilton Ave., Brooklyn, N. Y.	.5
2AJM	Requa, Reginald C.	Huntington, N. Y.	.5
2AJZ	Rice, Robert	715 St., Nicholas Ave., New York, N. Y.	.5
2AHZ	Richfield, Nicholas	554 W. 184th St., New York, N. Y.	1

SECOND DISTRICT—(Cont'd.)

Call signal	Owner of station.	Location of station.	Power kilowatts.
2AKB	Roberts, Hugh V.	118 New York Ave., Jamaica, N. Y.	.5
2AKH	Robinson, Christopher S.	113 Johnson St., Highland Park, N. J.	.5
2AJW	Schmelzer, Gerhard	7301 3d Ave., Brooklyn, N. Y.	.5
2AKX	Schwarz, Sylvan S.	30 Osborne Ter., Newark, N. J.	.5
2AJR	Secker, William	220 Wadsworth Ave., New York, N. Y.	.5
2ALJ	Spader, Wm. V.	103 1st Ave., Highland Park, N. J.	.5
2AKC	Stanley, Joseph J.	5 Hampton Court Ter., Jersey City, N. J.	.5
2AJN	Stenger, Harry C.	484 Onderdonk Ave., Brooklyn, N. Y.	.5
2AKA	Stewart, Guy A., Jr.	404 S. 1st Ave., Mt. Vernon, N. Y.	.5
2AJQ	Stratton, L. Brainerd	44 Seneca St., Oneida, N. Y.	.5
2AKI	Sypher, Edgar L., Jr.	138 New York Ave., Jamaica, N. Y.	.5
2ALH	Trautwein, Charles F.	853 S. 12th St., Newark, N. J.	.5
2ALD	Van Doren, Harold I.	120 Union Ave., Westfield, N. J.	1
2AJU	Wagerer, Lewis G.	122 Boulevard, Rockaway Beach, N. Y.	.5
2AKT	Warner, Stanley F.	221 S. Clinton St., E. Orange, N. J.	.5
2AKW	Warren, W. Harold	605 Munroe Ave., Asbury Park, N. J.	.5
2AJK	Weiss, Benjamin	96 Watkins St., Brooklyn, N. Y.	.5
2AJA	Wood, Charles	274 W. 135th St., New York, N. Y.	.5
2AKF	Woodruff, Gordon B.	459 Grove St., Westfield, N. J.	.5
2AKY	Young Men's Chris. Ass'n.	Asbury Park, N. J.	1

THIRD DISTRICT

Call signal	Owner of station.	Location of station.	Power kilowatts.
3AMK	Abdill, Geo, S.	125 E. Union St., Burlington, N. J.	.5
3AIB	Atkinson, T. Howard	423 E. State St., Trenton, N. J.	.5
3AMN	Bakley, Frank W.	300 9th St., Ocean City, N. J.	.5
3AMF	Beekman, Robert L.	Mt. Washington, Md.	.5
3AMS	Brandt, Bruce C.	932 Oak Hill Ave., Hagerstown, Md.	.5
3AMI	Brineshults, Ralph	Cedarville, N. J.	.5
3ANM	Bromley, George T., Jr.	222 N. Fulton St., Allentown, Pa.	1
3AMT	Brown, Raymond H.	633 10th St., N. E., Washington, D. C.	.5
3ANW	Brukhardt, Horace C.	1243 West Ave., Ocean City, N. J.	.5
3AND	Casey, Howard	230 S. Connecticut Ave., Atlantic City, N. J.	.5
3ANL	Chambers, Ivan F.	1519 Franklin St., Wilmington, Del.	.5
3AOI	Coblentz, Philip O.	Middletown, Md.	.5
3ANK	Cunningham, G. Blair	1419 Linden St., Allentown, Pa.	.5
3ACE	Davis, Lewis V.	Burlington, N. J.	.5
3PG	Dorsey, Arthur	3601 Greenmount Ave., Baltimore, Md.	.5
3AME	Ensor, John S.	Mt. Washington, Md.	.5
3AMA	Fow, Oscar A.	103 Summit Ave., Jenkintown, Pa.	.5
3AMG	Gains, George A.	804 W. Saratoga St., Baltimore, Md	.5
3ANF	Grier, George M.	114 W. 13th St., Wilmington, Del.	.5
3AMD	Hart, Robert M.	208 St. Martins Rd., Baltimore, Md.	.5
3NX	Heintzelman, Walter	312 N. 14th St., Allentown, Pa.	.5
3ANO	Henneberger, Hubert	15 Cannon Ave., Hagerstown, Md.	1
3AMP	Holloway, J. Q. A.	Mt. Washington, Md.	.5
3AMO	Linthicum, Robert E.	2013 Benning Rd., N. E., Washington, D. C.	.5
3NY	Lutz, John M.	119 E. Wildwood Ave., Wildwood, N. J.	.5
3AOD	McIver, Renwick S.	2036 O St., Washington, D. C.	.5
3ANT	Martin, George C.	1553 Ferry St., Easton, Pa.	1
3ANA	Miller, Marvin V.	801 Oak Hill Ave., Hagerstown, Md.	.5
3ANI	Montrose, Jack	5113 Viola St., Philadelphia, Pa.	.5
3AID	Rovins, Theodore	2021 N. 32d St., Philadelphia, Pa.	.5
3AMH	Sanders, Cecil W.	150 McCormick St., Clifton Forge, Va.	.5
3ANC	Schoble, Ralph T.	Wyncote, Pa.	.5
3SU	Seeley, Alfred J.	241 N. Wilton St., Philadelphia, Pa.	.5
3AOH	Shaffer, Sylvester	1017 Warden St., Baltimore, Md.	.5
3WK	Shannon, Frank	327 N. Wilton St., Philadelphia, Pa.	.5
3ANG	Shermer, Frank C.	4963 Wakefield St., Philadelphia, Pa.	.5
3AOG	Shoemaker, Joseph L.	718 Edgewood Ave., Richmond, Va.	.5
3ANE	Silbergerger, Fred E.	3406 N. 11th St., Philadelphia, Pa.	.5
3ANR	Sinkinson. Wm R.	2 11th St., Ocean City, N. J.	.5
3AOA	Sitvarin, Israel B.	42 Madison Ave., Woodbine, N. J.	.5
3ANS	Stacks, Thomas de A.	607 Reily St., Harrisburg, Pa.	.5
3AOF	Stiles, Ralph J.	510 Broad St., Cape May, N. J.	.5
3AE	Snyder, Edwin H., Jr.	1767 Columbia Rd., Washington, D. C.	.5
3ANH	Swartzkopf, Walter K.	1551 S. 58th St., Philadelphia, Pa.	.5
3AMW	Townsend, Lloyd	26 N. Massachusetts Ave., Atlantic City, N. J.	.5
3AML	Wessells, Wilbert T.	Newark, Del.	.5
3AMR	Ziegler, Lewis D., 3d.	5101 Pulaski Ave., Philadelphia, Pa.	.5
3ANP	Zimmerman, Harry F.	7 24th St., Wilmington, Del.	.5

FOURTH DISTRICT

Call signal	Owner of station.	Location of station.	Power kilowatts.
4DJ	Atkins, Charles A.	27 Candler St., Atlanta, Ga.	.5
4CC	Breden, Henry W.	1304 Myrtle Ave., Jacksonville, Fla.	1
4DL	Flowers, Robert B.	296 Rawson St., Atlanta, Ga.	.5
4DM	Gerlach, Harry J.	22 Ormewood Ave., Atlanta, Ga.	1
4DN	Hege, Wm. C.	1007 Patterson Ave., Winston-Salem, N. C.	1
4DK	Patterson, Clifford F.	508 Vine St., Atlanta, Ga.	1

FIFTH DISTRICT

Call signal	Owner of station.	Location of station.	Power kilowatts.
5DW	Breaux, Oscar W.	1472 N. Rochellave St., New Orleans, La.	.5
5BJ	Dye, Marvin M.	3107 Lee St., Dallas, Tex.	1
5CL	Fitzgibbon, Rodger K.	2002 Avenue P, Galveston, Tex.	.5
5CJ	Gray, W. Parker	15 W. 10th St., Oklahoma City, Okla.	.5
5BZ	Towle, Amoz	203 S. George Ave., Mobile, Ala.	.5

(To be Continued)

QUESTION BOX

This department is for the sole benefit of the electrical experimenter. Questions will be answered here for the benefit of all, but only matter of sufficient interest will be published. Rules under which questions will be answered:

1. Only three questions can be submitted to be answered.
2. Only one side of sheet to be written on; matter must be typewritten or else written in ink, no penciled matter considered.
3. Sketches, diagrams, etc., must be on separate sheets. Questions addressed to this department cannot be answered by mail.

TRANSFORMERS.

(566.) Morris Schoenfield, New York City, N.Y., writes:

Q. 1. What advantages have shell type transformers over those of the core type?

A. 1. They have a larger proportion of core surface exposed for radiation of heat and a shorter magnetic circuit, which reduces the tendency for a leakage of the line of force into the air.

Q. 2. Why is the reciprocating steam engine being largely replaced by the steam turbine, especially for the larger units?

A. 2. Because of the turbine's higher rotative speed and absence of a multiplicity of bearings, which in the case of a high speed reciprocating engine must be maintained in very close adjustment for the proper operation of the engine. The angularity and general design as well as the to and fro motion limit its operating speed. High steam velocity may be used successfully in turbines and high speeds are not only possible but practical.

INTEGRATING PHOTOMETER.

(567.) George Ackelman, Brooklyn, N.Y., asks:

Q. 1. What is an integrating photometer?

A. 1. A photometer which gives directly by one reading the average light emitted around a meridian line.

Q. 2. What is meant by candle foot?

A. 2. The illumination produced by a light of one candle power at a distance of one foot from a screen one foot square.

Q. 3. What is the relation between voltage and illumination?

A. 3. The candle power of the light increases much faster than the voltage. For example, a carbon lamp intended to give 16 c.p. at 105 volts will give 12.5 at 103 volts or 19 at 107 volts.

VOLTAGE OF SHUNT DYNAMO.

(568.) Louis Black, Jersey City, N.J., inquires:

Q. 1. How does the field of a shunt dynamo build up?

A. 1. After the machine is stopped, the iron retains more or less magnetism, being in fact, a semi-permanent magnet. This residual magnetism furnishes a weak field which causes a small E.M.F. to be induced in the wires on the armature, as the machine is started. If the armature and field coils form part of a closed circuit, the small E.M.F. induced by the residual magnetism sends a small current through the circuit. This current then strengthens the magnetic flux in the field and causes a still higher E.M.F. to be induced. This again sends still more current through the field coils, and the machine thus quickly builds up its magnetism, and the voltage to full strength.

Q. 2. What prevents the voltage of a shunt dynamo from increasing indefinitely?

A. 2. The machine is so designed that the iron of the field magnet becomes more or less saturated by the time the voltage has risen to the desired amount. The magnetic effect is, moreover, dependent upon the speed of the inductor moving through it; the greater the speed, the higher the voltage.

TRANSMISSION RANGE.

(569.) Bernard Edelman, Jamaica, L.I., wishes to know:

Q. 1. The distance that he can cover with the following transmitting apparatus: 2 inch spark coil, condenser, helix, spark gap and an aerial composed of four wires, 60 feet long and 70 feet high.

A. 1. The distance that you should be able to cover with your instruments will be about ten to fifteen miles under favorable weather conditions.

Q. 2. What is the natural wave length of my aerial?

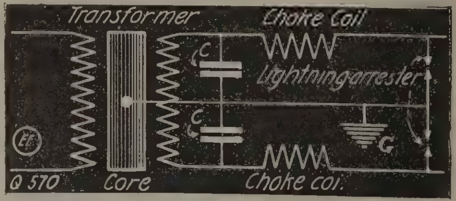
A. 2. The natural wave length of your aerial is 240 meters.

STATIC INTERRUPTERS.

(570.) John Hanly, Montgomery, Ala., wants:

Q. 1. A description of a static interrupter.

A. 1. A static interrupter is a combination of a choke coil and a condenser, the two being mounted together and placed in a tank of insulated oil. It is used on high pressure circuits and its function is to delay the static wave in its entry into the transformer coil, that a considerable portion of the latter will become charged before the terminals will have reached the full pressure.



Static Interrupter Protector for High Tension Transformer Lines

Q. 2. How is the choke coil and condenser connected to the transformer?

A. 2. The diagram herewith given shows the proper connections for the choke coil and the condenser.

Q. 3. What is the effect of the condenser in the static interrupter?

A. 3. The condenser, which has a very small electro-static capacity, has no appreciable effect upon the normal operation, but a very powerful effect upon the static wave, on account of its extremely high frequency.

HYSTERESIS.

(571.) Carl Jensen, San Francisco, Cal., writes:

Q. 1. What becomes of the energy lost by hysteresis?

A. 1. It is converted into heat. An armature or transformer whose iron is hard will heat much faster than one whose iron is carefully annealed and soft, since the area of the hysteresis cycle or loop is larger. The chemical purity of the iron has much to do with the amount of hysteresis loss also.

Q. 2. What is the chief objection to a belt drive?

A. 2. The large amount of floor space required and inefficient method of transmitting power, principally due to slippage of the belt on the pulleys.

GROUND WIRE.

(572.) Clark Bell, Hardins, Mont., would like to know:

Q. 1. If a copper wire 5/16" in diameter will do for a wireless ground?

A. 1. A 5/16" copper wire is suitable for a ground wire.

Q. 2. Is it possible to receive stations located in Iowa with proper apparatus at this point?

A. 2. There is no reason why Iowa stations cannot be received with proper apparatus.

LOGARITHMIC DECREMENT.

(573.) John Hancock, Toledo, Ohio, asks:

Q. 1. What is the logarithmic decrement?

A. 1. The decrement is the amount of decay in the oscillations of a transmitting wave. This is due mainly to resistance in the entire transmitting circuit. It is measured either by using a decremeter or else by plotting the characteristic curve of the emitted wave, which is perhaps somewhat difficult in stations employing high frequency. If such a wave is photographed by a revolving mirror, and the amplitude of two successive waves in the same direction is measured, the percentage of damping is determined by dividing the smaller by the larger values. To calculate the logarithmic decrement, take the log of the fraction obtained and multiply by 2.3026, or take the natural logarithm of the per cent. of decrement. The best and most accurate method, however, is to employ a decremeter.

FREQUENCY METER.

(574.) Pierpont Wright, Bronx, New York, wants:

Q. 1. A brief description of a frequency meter of the induction type.

A. 1. A frequency meter of the induction type consists of two voltmeter electromagnets acting in opposition on a metal disk attached to the pointer shaft. One of the magnets is in series with an inductance and the other with a resistance, so that any change in the frequency will unbalance the forces acting on the shaft and cause the pointer to assume a new position, when the forces are again balanced. The aluminum disk is off center, so that when the shaft turns in one direction the torque of the magnet tending to rotate it decreases while the torque of the other magnet increases. The pointer, therefore, comes to rest where the torques of the two magnets are equal, the pointer indicating the frequency directly on the scale.

Q. 2. What are some of the objectionable features of single phase alternators?

A. 2. A single phase alternator has an unbalanced armature reaction which is the cause of considerable flux variation in the field pole tips, and in fact throughout the field structure.

In order to minimize eddy currents, such alternators must accordingly be built with thinner laminations. The large armature reaction results in a much poorer regulation than that obtained with three phase alternators.

(Continued on page 274)

IMPROVEMENT NOTICE

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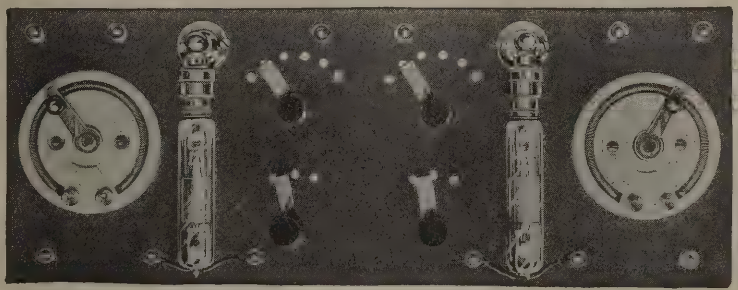

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If name of Course you want is not in this list, write it here.

QUESTION BOX.

(*Continued from page 272*)

LOADED TELEPHONE CABLES.

(575.) N. A. K. Bugbee, Philadelphia, Pa., asks several questions regarding loaded telephone cables:

Q. 1. How are telephone cables loaded on the Pupin theory, and how far apart are the coils placed?

A. 1. The effect of adding inductance coils to a telephone cable is to augment the inherent self-inductance of the line and thus counteract to some extent the storage of energy in the line, due to its capacity. In practice, the inductance coils are placed at regular intervals along the cable. It is usual to space them about 2½ miles apart on a 100 mile circuit, thus giving 40 loading coils in this length of line.

The coils are usually wound on a laminated iron ring. The winding is of insulated magnet wire wound over the core. The direct current resistance is about 3 ohms. With alternating currents of telephonic frequency passing through it, its resistance is nearly doubled. By adding inductance to the line in this fashion it is thus apparent that resistance is being added also. The predominating problem in designing loading coils therefore is to keep the resistance low and the inductance high.

Where phantom circuits are concerned, special loading coils are used, as the coils hooked-up in the physical circuits exert no loading effect on the phantom. All four wires of the cable system are wound on phantom circuit coils.

In general, the amount of inductance added to a telephone circuit by the insertion of standard loading coils, spaced 2½ miles apart, is 50 milli-henrys per mile, or each coil has an inductance of 125 milli-henrys. The improved talking efficiency gained by this amount of loading is, on the average, such as to make a loaded circuit of a given gauge number about three times as efficient as an unloaded circuit of the same gauge (wire size). The rate of improvement in efficiency increases slightly with the increase in gauge of conductor. However, the rate of copper saving increases much faster. Naturally there is a limit to the amount of loading which may be usefully added to any telephone circuit. Usually it is considered sufficient, when enough inductance has been added to exactly counteract or neutralize the inherent electrostatic capacity of the circuit. When inductance is added beyond this point, the circuit is said to be *over-loaded,* and oftentimes under such conditions, the real over-all efficiency may be less than that of an unloaded circuit. American practice calls for much heavier loading on long lines than obtains in England or on the Continent. Each, however, covers different requirements in a satisfactory manner.

PUPIN'S NON-INTERFERENCE ANTENNA.

(576.) Karl Nyquist, Stronsburg, Neb., wishes to know:

Q. 1. Where he can obtain information regarding Pupin's Non-Interference Antenna.

A. 1. We doubt very much as to whether you can get any information on this new non-interference antenna, as research work is still being conducted by Professor M. I. Pupin. You might write to Professor Pupin of Columbia University, New York, regarding his new aerial.

Q. 2. Would it be possible to do sharper tuning with a loose coupler if the wire on the primary and secondary is of the same size?

A. 2. You can tune as sharply with your coupler, providing, of course, that a variable condenser is shunted across the secondary.

Q. 3. What instruments besides a variometer are required to do very sharp tuning?

A. 3. A variable condenser will be required in conjunction with a variometer in order to obtain sharp tuning with your set.

CHOKE COIL QUERY.

(577). F. S. Taylor, Pittsburgh, Pa., writes:

Q. 1. Whether he can use a choke coil of proper design to reduce 110 volt, 60 cycle current to supply a low-voltage, ¼ H.P. induction motor, for driving a wash wringer.

A. 1. A choke coil can be used for reducing the 110 volts to the proper voltage for the induction motor.

Q. 2. He submits a design of a choke coil and wishes us to give him our opinion of same.

A. 2. The design which you have given is good, but we suggest that the size of the wire be increased to No. 12 B. and S. cotton covered magnet wire, and the number of turns be reduced so as to obtain the greatest amount of power for supplying the motor when an overload occurs.

Q. 3. What would be the efficiency of the choke coil?

A. 3. There should be no trouble in obtaining about 75 to 80% efficiency with the motor when employing this choke coil.

TRANSFORMER QUESTION.

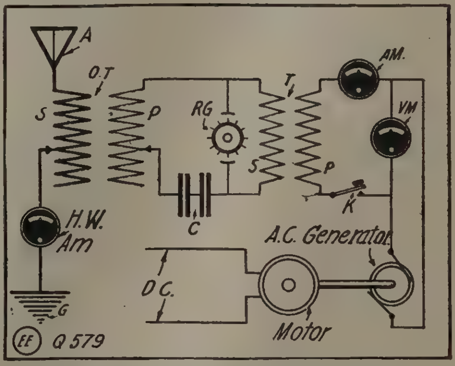
(578.) E. A. S., Bayle, Ind., asks:

Q. 1. How much current in amperes will a ½ K.W. transformer coil produce, and how much of the current will the aerial take up?

A. 1. The transformer will deliver about ¼ to 1 ampere of high frequency current to the aerial, when the transformer operates at its maximum efficiency.

Q. 2. What voltage, amperage and watts will a 75 ohm telephone receiver stand continuously without heating?

A. 2. The telephone receiver will stand about .13 amperes at a pressure of 10 volts, equivalent to 1.3 watts.



Hook-up for Complete Radio Transmitting Outfit with Measuring Instruments.

HOOK-UP.

(579.) Fred Miles, Queensborough, N.Y., inquires:

Q. 1. If a silicon crystal is more sensitive than galena.

A. 1. It is somewhat difficult to answer this, as some grades of silicon crystals are more sensitive than others, and the same rule holds good for galena. However, if two sensitive pieces of both crystals are obtained, and if a proper contact is made on them, it will be found that the galena is somewhat more sensitive, although the silicon is more stable than galena, as it does not require such a light contacting wire.

Q. 2. Can an electrolytic detector be made to oscillate so as to receive undamped waves by the heterodyne principle?

A. 2. The electrolytic detector cannot be made to oscillate so as to produce *beats.*

Q. 3. A diagram of the following: Motor-generator, voltmeter, ammeter, transformer, condenser, rotary gap, oscillation transformer, key and hot wire ammeter.

A. 3. Our diagram gives a proper hook-up of the above instruments.

WAVE LENGTHS.

(580.) J. Anderson, Memphis, Tenn., asks:

Q. 1. What is the wave length of my aerial composed of four wires, 400 feet long and 80 feet high?

A. 1. The natural wave length of your antenna is 660 meters.

Q. 2. What is the transmission range of the new de Forest radio telephone set, employing an oscillion bulb as a generator for the high frequency current?

A. 2. The average transmission range of this radio telephone outfit is about 3 to 8 miles under favorable conditions.

Q. 3. Can an ordinary audion tube be employed as a generator of high frequency currents?

A. 3. Audion tubes can be used as generators for producing high frequency currents provided they are properly connected. The current produced by them is so small that they are practically useless for generators of high frequency currents in radio-telephonic work.

RADIO TELEPHONY.

(581.) T. La Blanc, Havana, Cuba, wishes to know:

Q. 1. What is a closed circuit wireless telephone?

A. 1. A closed circuit wireless telephone is a system of radio-telephonic communication in which the earth is used as the carrier of the electric current. It consists of two large metal plates, buried in the ground. These are widely separated from each other. Two sets are employed, one for the transmitter and the other for the receiver. A telephone transmitter and a battery of high voltage and amperage are connected in series with one set of plates, while a wireless receiver and battery, connected with the other set of plates comprise the receiver.

Q. 2. How far can such an installation work?

A. 2. About 3 miles, depending upon the character of the ground in which the plates are buried, the distance between the plates, and the strength of the current used. By keeping the plates farther apart, greater distance can be covered.

RECTIFIER.

(582.) H. Hickens, Toledo, Ohio, inquires:

Q. 1. Is a motor-generator more suitable for charging storage batteries, employing alternate current, than an electrolytic rectifier?

A. 1. A motor-generator is more suitable than an electrolytic rectifier for charging storage batteries.

Q. 2. What is the chemical salt used in preparing the solution for an electrolytic rectifier?

A. 2. Ammonium phosphate is commonly used.

Q. 3. What is the advantage of the electrolytic rectifier over the mercury type?

A. 3. It is cheaper to buy or build.

(*Continued on page 278*)

ELECTRO-SET NEWS and BARGAINS

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In perfect condition. Resistance about 600 ohms. Size 3½ inches long, ¾ of an inch in diameter. Core drilled and tapped at one end for 8-32 machine screw. Fibre ends. Norway core. Heavy rod contacts. Wound with No. 36 pure silk covered copper wire. Worth 40 cents. Shipping weight 1 lb. for three, postage extra. **Our special price until sold three for 25 cents.**

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Universal Detector 50c.

The most sensitive and complete detector ever produced at anywhere near this price. Mineral holder is a strong saw-toothed clip and the phosphor bronze cat whisker is removable. Messages may be received almost any distance with this detector which is offered at the unusually low price of 50c. Shipping weight 9 oz.

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"USE RADIOCITE IN YOUR DETECTOR AND FORGET IT"

RADIOCITE is the most wonderful of all radio crystals. It is more sensitive than Galena and far more sensitive than ANY other crystal or mineral. RADIOCITE is a specially selected grade of a rare crystal chemically treated by our own secret process.

WHAT IT IS

The mineral that looks like liquid gold. It has a highly, wonderfully polished surface giving it a perfectly burnished appearance. This crystal is now in use by several governments, and is conceded to be the most satisfactory of all. It is used with a medium stiff phosphor bronze spring, or with a stiff silver wire, about No. 30 B. & S. Gauge.

One of the important features of RADIOCITE is that it does not jar out easily. Each crystal is *tested for sensitivity* and guaranteed. RADIOCITE comes packed separately in a box, wrapped in tin-foil. Full directions accompany it. RADIOCITE can be mounted like any other crystal; it may be clamped between springs, but it is best to set it in *Hugonium* soft metal. Money refunded if our claims are not substantiated.

No. 3939. Generous piece of tested RADIOCITE. **Prepaid, $0.50.**

THE ONE UP-TO-DATE MINERAL WHICH EVERY AMATEUR MUST HAVE

WHAT THEY SAY:

The letters which we publish herewith tell our story far better than we could. Hundreds of enthusiastic testimonials fill our files Read and see what these well-known amateurs from all parts of the country say. Can you afford to be without RADIOCITE?

E. I. Co., N. Y. Lanark, Ill.

My dear Sirs:

Regarding your new detector crystal *Radiocite* wish to advise that I have received the crystal.

I have used and given same a careful test and *am surprised* at the results received with it. I really consider it a better grade of crystal *than any Galena I ever tried.* Although my station includes an Audion Detector, *I much prefer the Radiocite* for amateur work, for it is very easy to keep adjusted; NAA comes clear as a bell. I will be glad to recommend your crystal to anyone.

Yours very truly,
E. H. GIDDINGS
Radio Station 9MK., Lanark, Ill.
Telegraph Operator, C. M. & St. P. Ry.

The E. I. Co.,
New York, N. Y. Owego, N. Y.

Gentlemen:

I have thoroughly tested your, *Radiocite*, and find it very stable *withstanding very severe static* and holding a very sensitive adjustment for several days without touching on a table subjected to considerable jarring. Another detector setting beside it would not hold its adjustment but for a short time. It is easy to adjust, and of the several kinds of minerals used by me I consider it the most sensitive. I would recommend *Radiocite* to all amateurs and others who desire a detector easily adjusted, very sensitive, and one which will hold its *adjustment indefinitely and stay sensitive.*

Yours respectfully,
H. G. SMITH.

E. I. Co., N. Y. Littleton, Mass.

Dear Sirs:

That *Radiocite* crystal is one of the best I have used. The first time I tried it stations came in great, some I had never heard before. I hear N.A.A. so loud that I can lay the phones on the desk and hear them. Very truly yours, JACK HARDY

St. Paul's M.E. Parsonage,
E. I. Co., N. Y. Penn's Grove, N. J.

Dear Sirs:

I received my *Radiocite* O. K. and have had splendid results with it. It brought in signals clearer than *Galena* or other minerals I have used. I think it will please everybody.

WM. OGBURN LYNCH

E. I. Co., N. Y. Le Roy, N. Y.

Dear Sirs: June 21st

I have thoroughly tested the *Radiocite* which I received from you and find it far superior in all respects to *Galena, Silicon* or any other mineral I have ever used.

Respectfully yours,
WM. N. TOWNER

E. I. Co., N. Y. 729 Euclid Ave., Baltimore, Md.

Dear Sirs:

I could not express my satisfaction with the new mineral *Radiocite. It is more sensitive than any crystal detector* I have ever tried. It is also permanently sensitive and *is not knocked out by the ½ K.W. open core transformer* which I use for sending. I remain your true friend,

W. J. POHLMAN

404 Mt. Prospect Ave.,
E. I. Co., N. Y. Newark, N. J.

My dear Sirs:

I received your tested *Radiocite* and find it excellent. As soon as I received it, I put it in the cup, put the detector spring on and N.A.H. came in so loud he could be read *sixteen feet from the phones.*

Yours truly, HENRY D. WILSON, Jr.

Electro Importing Co.,
236 Fulton Street, New York City.

On your absolute guarantee that RADIOCITE is exactly as described by you, I enclose herewith 50 cents in ....for which you are to send me *prepaid* one box containing a generous piece of *tested Radiocite.* You accept my money with the understanding that you will refund it to me at once, should I find the RADIOCITE unsatisfactory. *You guarantee to ship within twenty-four hours or return my remittance.*

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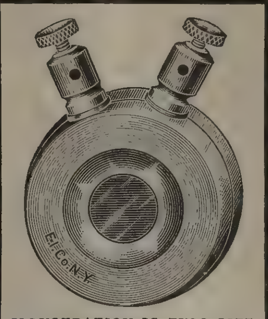

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Our illustration shows the full size of the cell. It is built in form of a watch and is entirely foolproof. There are no screws, no loose wires—nothing to get out of order. The over-all size is 1½"x1¼". The selenium surface is protected by glass and can therefore not be injured, even if roughly handled. The active selenium surface measures ⅜" in diameter—a very large surface and much larger than found in the best cells. The current is supplied to the cell by means of two neat binding posts. The metal case is nickel-plated.

The ratio of these cells is remarkable. Thus a typical cell in the dark measures 96,000 ohms, while if exposed to a 40 c. p. tungsten lamp, the resistance drops to 12,000 ohms. This is a ratio of 8 to 1 which is remarkable and bespeaks of the high quality of the construction. Every cell is guaranteed and we will replace any not giving satisfaction.

IMPORTANT. When ordering state if you wish a high resistance or a low resistance cell.

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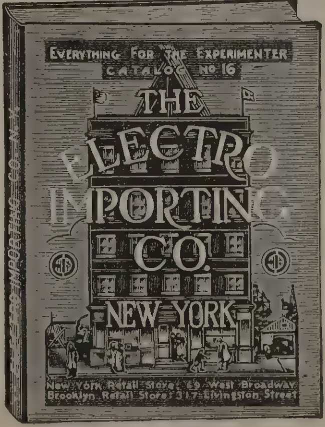
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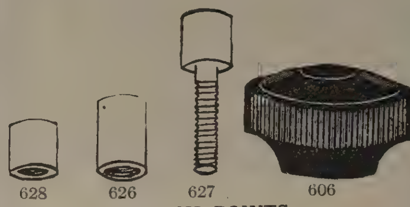

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Closed Core Type Self Contained 14.000 VOLTS 3 Different Powers Shipping Weight—20 lbs.

Folders and information descriptive of these ¼ K. W. transformers may be had for the asking—also of our 500 and 750 watt capacities.

Winger's Code Charts—large size **Continental—Post Paid—15c.,** small or pocket size **10c.** They enable you to learn the code **More Quickly** than by any other method.

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QUESTION BOX.

(Continued from page 275)

RADIO TIME SIGNALS.

(583.) Verne Schuman, Missouri, writes:

Q. 1. What is the receiving range of a radio set consisting of an 800 meter loose coupler, fixed condenser, galena detector, 2,000 ohm headset, and inverted "L" type aerial 50 feet long and about 50 feet high?

A. 1. You should have no trouble in receiving stations from about 300 to 400 miles.

Q. 2. Could I receive the time signals if I used a loading coil?

A. 2. We doubt very much whether you would be able to receive time signals when you add a loading coil, as your aerial is small and your receiving instruments are not sensitive enough to receive Arlington. However, we would suggest that you add a vacuum detector and variable condenser to your set, and lengthen your aerial to 100 or 150 feet.

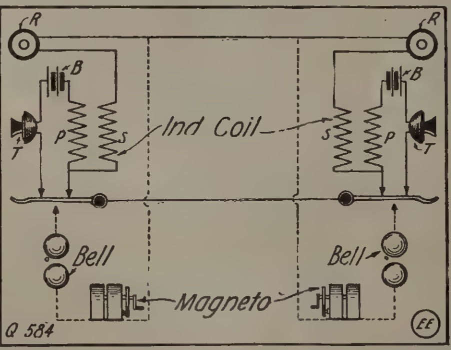
TELEPHONE DIAGRAM.

(584.) Paul Simpson, Newark, N.J., writes:

Q. 1. Please give telephone diagram employing batteries and magneto for ringing purposes.

A. 1. The diagram given herewith shows the proper connections.

Q. 2. What is the synchronous speed of a 12 pole induction motor operating on a 60 cycle circuit, and how do you obtain the result?



Connections for "Magneto Call" Telephone System. The Magneto Is Usually Equipped with an Automatic "Shunt" Allowing the Bell to Ring without the Current Having to Pass Thru the Impedance of the Magneto Armature.

A. 2. The synchronous speed of the induction motor is 600 R.P.M. and the result is obtained as follows:

$$R.P.M. = \frac{2f}{P} \times 60$$

where f=frequency in cycles per second
P=number of poles

so $\frac{120}{12} \times 60 = 600$ R.P.M.

DYNAMO QUERIES.

(585.) I. Haynes, Little Rock, Ark., asks:

Q. 1. What should be done if a dynamo is overloaded?

A. 1. If the current is more than 50 per cent above the rated capacity of the dynamo, and if it continues more than a few minutes, the main switch should be opened. If the machine is supplying a lamp load whose sudden extinction might cause a panic and endanger human life, one should risk injury to the dynamo rather than open the circuit. When it is unsafe to shut down, the dynamo may be relieved by changing the regulator so as to lower the voltage, until the lamps give only a dim light. The current will decrease with the voltage. Modern built machines will carry 50 per cent overload for two hours safely.

Q. 2. How can a dynamo lose its residual magnetism?

A. 2. A dynamo may lose its residual magnetism by rough handling or by standing long unused. Sometimes the armature reaction, due to a heavy short circuit, will demagnetize or even reverse the field magnet. Sometimes also, the induction current due to lightning will demagnetize or reverse the field.

In some power stations this trouble is often experienced due to the fact that the field of the dynamo is situated so that the earth's magnetic field passes through it at right angles. The field should be placed in the magnetic meridian, i.e., in a line from north to south.

Q. 3. What remedy should be applied when a dynamo becomes reversed?

A. 3. Reverse the residual magnetism by current from another machine or from a battery. If this is not convenient, the connections between the machine and the line may be transposed or crossed, so that what was formerly the positive terminal of the dynamo is now the negative, and vice versa.

DYNAMOMETER.

(586.) Edward Pierce, Cleveland, Ohio, wishes to know:

Q. 1. How does a dynamometer work?

A. 1. When current is passed through both coils, the movable coil is deflected against one of the stop pins. Then the torsion head is turned to oppose the movement until the deflection has been overcome, and the coil brought back to its original position. The angle through which the torsion head was turned, being proportional to the square root of the angle of torsion, is multiplied by the calculated constant furnished by the maker of the instrument.

Q. 2. How is the dynamometer arranged to measure watts?

A. 2. When measuring watts, the instrument should be so arranged that one coil carries the main current, and the other a small current, which is proportional to the pressure or voltage.

TURBINES.

(587.) Charles Applebaum, Chicago, Ill., requests:

Q. 1. A description of an impulse turbine.

A. 1. One in which the fluid is directed by means of a series of nozzles, against vanes which it drives.

Q. 2. What is a reaction turbine?

A. 2. One in which the pressure or head of the water is employed rather than its velocity. The current is deflected upon the wheel by the action of suitably disposed guide plates, the passages being full of water. Rotary motion is obtained by the change in the direction and momentum of the fluid.

Q. 3. How many classes of reaction turbines exist?

A. 3. There are three classes of reaction turbines, namely, the parallel flow, inward flow and outward flow.

WIRING FORMULA.

(588.) Gaston Lang, Los Angeles, Cal., wishes:

Q. 1. A formula for calculating the size of wire used in single phase alternating current circuits.

A. 1. The formula which you desire for figuring out the size of wire used in alternating current lighting circuits is herewith given:

$$S = \frac{C \times L \times 21.6}{D}$$

where

S=cross sectional area of the wire in circular mils.
C=current in amperes.
L=length in feet one way.
21.6=a constant.
D=drop in volts.

Still another formula that can be used is:

$$S = \frac{W \times L \times K}{\%\,Loss\ Vts. \times V}$$

where

S=cross sectional area of conductor in circular mils.
W=watts.
V=volts.
L=length in feet.
K=2,160 for D.C.; 2,400 for single phase, all lights; 3,000 for single phase, motors and lights; 3,380 for single phase, all motor load.

The per cent of loss is determined by employing this formula:

$$\%\ \text{loss} = \frac{D}{V_1} \times 100$$

where

D=drop in volts,
V_1=impressed voltage,
100=a constant.

INDUCTION MOTOR.

(589.) Frederick Gensen, Middletown, Conn., asks:

Q. 1. How is the speed varied in induction motors?

A. 1. There are several methods used for changing the speed of induction motors, one of which is by taking off taps from the motor windings, and by the aid of a double throw switch, the number of poles can be changed to half of the previous number. This, however, only gives two speeds. Three-speed motors are sometimes made applying the above principle. For gradual variation in speed, resistance may be inserted in series with the primary winding, and as the E.M.F. per phase is cut down, the torque becomes less and the speed decreases. In some a variable resistance or impedance is inserted in the rotor circuits.

Q. 2. Why is iron more largely used in the frame of covers of induction meters than in direct current meters?

A. 2. Iron has very little chance to be permanently magnetized on the induction meters, as they are exclusively operated on alternating current.

Q. 3. What causes humming and rattling in induction motors?

A. 3. Humming and rattling are usually due to vibrations of loose parts.

FLAMING ARC.

(590.) Walter Hickshaw, Boston, Mass., asks:

Q. 1. What is a flaming arc?

A. 1. The flaming arc lamp uses electrodes consisting of a carbon shell with a core of powdered carbon, mineral salts and a suitable binder. The mineral salts make the arc highly luminous, so that the total amount of light is about triple that from ordinary carbons, using equal energy. On account of the fumes and the residue from the mineralized carbons, the arc must be well ventilated, and it is best suited for exterior lighting. The electrodes are usually inclined, making a narrow "V" and throwing most of the light downward, the arc being deflected by an electromagnet.

Q. 2. What methods are used for taking the static electricity away from shafting and machines?

A. 2. The best way is to ground the hangers or some other stationary part, by

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Make your wireless reach greater distances—transmit hundreds of miles further—with a THORDARSON WIRELESS TRANSFORMER. We constantly receive news of unusual distances attained with the aid of the THORDARSON—often as high as 1000 miles. Gives a stronger, steadier spark, instantly adjusted **without disconnecting transformer or cutting off current.** Amateurs everywhere are getting the best results with the

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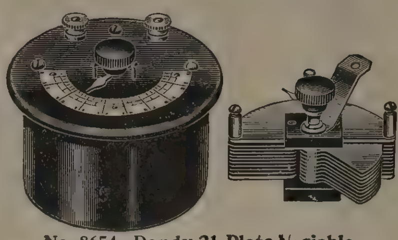

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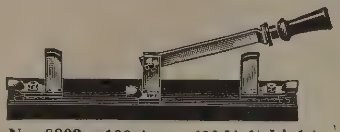

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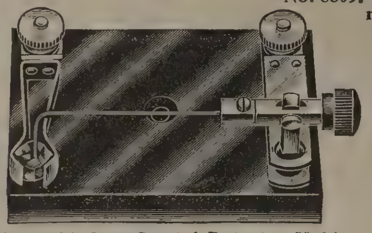

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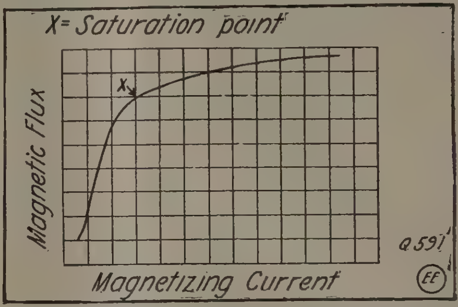
means of a wire fastened to a water, gas or steam pipe, or to a rod driven into damp earth. For wooden pulley drives a grounded metallic comb is placed about ½ inch from the belt.

MAGNETIC SATURATION OF IRON.

(591.) John Warlet, Brooklyn, N.Y., wants to know:

Q. 1. What is meant by the magnetic saturation of iron?

A. 1. This may be explained by the accompanying curve, in which the curved line represents the relation between the magnetizing current and the resulting magnetization. After the iron has been magnetized once, it retains a certain amount as indicated by the curve, beginning at some distance above zero. For small magnetizing forces, the permeability of iron is small and the magnetism increases slowly. The permeability then increases, and the magnetization increases rapidly until the iron approaches the *saturation limit.* The upper sharp bend in the curve is called the saturation point, since after the iron has been magnetized up to this point, it is difficult to magnetize it much more strongly.



Showing Saturation Point or "Knee" of Magnetization Curve for Iron. Beyond point "X" the Proportionate Amount of Ampere-Turns Required for Increase in Flux is Very High

OZONE.

(592.) Paul Gilber, St. Louis, Mo., inquires:

Q. 1. How is ozone made?

A. 1. Ozone is made from the air which is electrified. An ozone generator consists of two conducting surfaces which are well insulated from each other, and placed at such a distance apart that when oppositely charged there will be a *silent* discharge between them as the electricity slowly passes from one to the other across the intervening air. When air passes between such a surface, the oxygen of the air, which is composed of two atoms to the molecule, is dissociated, and recombines into ozone. Each molecule is then composed of three atoms.

Q. 2. What is a line of force?

A. 2. A line of force is the expression used to indicate either the direction or the strength of a magnetic force. The *unit magnet pole* is a magnetic pole of such strength that it will repel an equal pole with a force of 1 dyne when at a distance of 1 centimeter apart. Any magnetic field in which such a unit pole is attracted or repelled with a force of 1 dyne is said to have a strength of *one line of force per square centimeter.*

SKIN EFFECT.

(593.) Henry Kamfort, Orange, N.J., wishes to know:

Q. 1. What is skin effect?

A. 1. This is the tendency of alternating currents to avoid the central portions of solid conductors, and to flow or pass over the outer part of the conductor. Skin effect is a very important problem in all high frequency work.

Q. 2. What is the explanation of skin effect?

A. 2. It is due to eddy currents induced in the conductor.

Q. 3. What is the reactance of an alternating current having a frequency of 133 cycles passed through a coil whose inductance is .3 henry. How do you obtain the result?

A. 3. The *inductive* reactance of current is 250.7 ohms and this is obtained by substituting the proper values in the following formula:

$$X=2\pi FL$$

where

X=inductive reactance in ohms.
2π=constant (π=3.1416).
F=frequency in cycles per second.
L=inductance in henries.

Here X=2x3.1416x133x.3=250.7 ohms.

Q. 3A. What current would flow through such a coil, its measured resistance being 10 ohms and the line potential 100 volts (effective)?

A. 3A. The effective current in amperes is given by the expression:

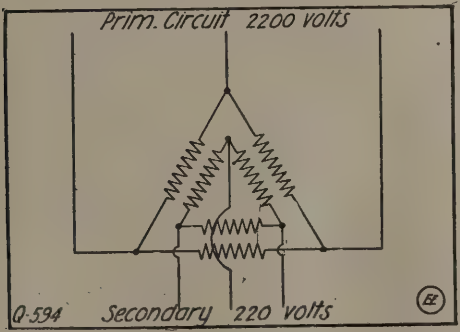
$$I=\frac{E}{\sqrt{R^2+X^2}};$$

where

E=effective volts.
I=effective amperes.
R=ohmic resistance (measured or D.C.).
X=inductive reactance in ohms.

Hence I is in this instance:

$$I=\frac{100}{\sqrt{10^2+250.7^2}} \text{ or .39 ampere}$$



Delta Connection of Three Transformers on a Three Phase A. C. System.

TRANSFORMER CONNECTION.

(594.) Paul Dikeman, Atlanta, Ga., asks:

Q. 1. What is a delta connection and how is it made?

A. 1. In the delta connection both primaries and secondaries are connected in delta grouping, as shown herewith.

Q. 2. What advantage has the star connection over the delta connection?

A. 2. Each star transformer is wound for only 58% of the line voltage. In high voltage transmission this admits of much smaller transformers, built for high pressure than is possible with the delta connection.

ARMATURE.

(595.) I. Langton, Columbus, Ohio, wants to know:

Q. 1. How is the armature of a booster alternator connected?

A. 1. It is connected in series with the input circuit on the converter.

Q. 2. How are the field windings connected?

A. 2. They are either fed with current regulated by means of a motor-operated field circuit rheostat, or joined in series with the commutator leads of the converter.

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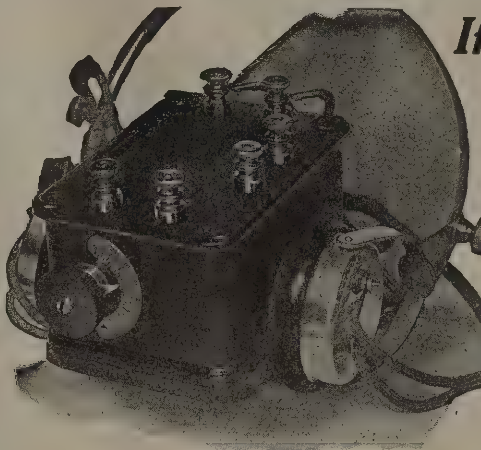

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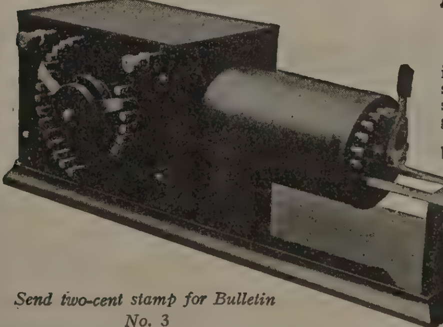

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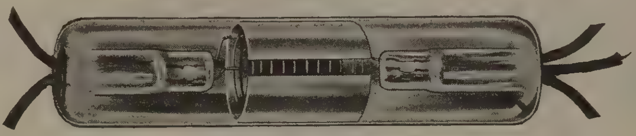

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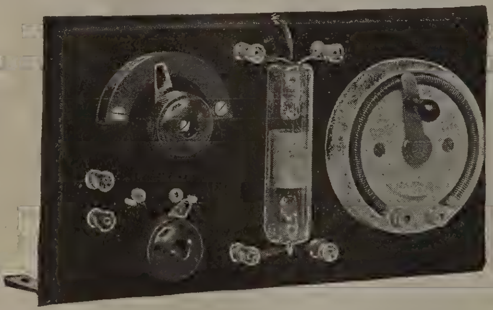

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HEAT CALCULATION.

(596.) K. Frieden, Hoboken, N.J., would like to know:

Q. 1. What is the relation between voltage and candle-power in regard to an incandescent electric lamp?

A. 1. The candle-power of the light increases much faster than the voltage.

Q. 2. What is meant by the *smashing point* of an incandescent lamp?

A. 2. As a lamp gets old its candle-power and efficiency drop off, so that after a certain point it becomes cheaper to throw a lamp away, or to smash it and get a new one, than it is to continue to use the old one. The smashing point is generally reached when the candle-power of the lamp has fallen to 80% of its initial value.

RADIO ENGINEERS HOLD JUNE MEETING.

At the June meeting of the Institute of Radio Engineers, held on Wednesday evening, June seventh, at the Engineering Societies Building, 33 West Thirty-ninth Street, New York City, a paper on "Arc Oscillations in Coupled Circuits" by Professor Hidetsugu Yagi of the College of Engineering at Sendai, Japan, was presented. The efficient transfer of energy from the primary to the secondary and the production of overtones were fully treated upon in an interesting way. The paper was illustrated by many valuable, experimentally determined curves, showing the action and interaction of the oscillations in various types of circuits.

$25.00 TO ANYONE WHO SOLVES THIS ELECTRICAL PROBLEM.

(*Continued from page 241*)

We wish to mention for the guidance of possible contestants that common schemes employing condensers across the interrupter "break," magnetic blow-outs, resistances and inductances connected across the circuit-breaker, etc., have been thoroughly tried out *without success.* Therefore the solution is not as easy as would seem at first glance. We feel confident, however, that there is a successful way to operate the circuit.

The above problem can undoubtedly be solved by anyone who will concentrate his mind on it. Every experimenter, student and engineer should try a hand at this interesting problem. The result of the contest will be published in an early issue. The editors of this publication wish to state emphatically that the offer here made is thoroughly genuine. We have stated the problem; solve it correctly and the money is yours.

Important. Please note, that it is not of paramount importance to improve the present interrupter; *the main object is to vibrate B as set forth above.* Any new interrupting scheme that does the work satisfactorily will solve the problem. No commutator schemes can be used as these are patented already.

All communications should be addressed to "Editor Interrupter Contest," and the following rules should be observed.

Sheets should be written on one side only.

No pencil writing acceptable.

Drawings must be on a separate sheet; all drawings to be in pen and ink.

In case the idea proves acceptable to the Piano Company, on paying $25.00 for the idea, they immediately assume control of the device as well as all patent rights belonging thereto. The sum of twenty-five dollars has been deposited with the Experimenter Publishing Co., to be paid over to the winner. The contest closes August twentieth and no letters will be considered after that date.

STANDARD RADIO TERMS DEFINED.

Approved by the Institute of Radio Engineers.

Under this head we will define the most important radio terms each month. Save them and by pasting each in a book (properly indexed) you will have a handy radio dictionary.

53. *Decrement, Linear, of a Linearly Damped Alternating Current:* This is the difference of successive current amplitudes in the same direction divided by the larger of these amplitudes.

Note: Let I_n and I_n+1 be successive current amplitudes in the same direction of a linearly damped alternating current.

Then, the linear decrement

$$b=\frac{I_n-I_n+1}{I_n}$$

Also: $I_t = I_o(I - bft)$,
where I_o = initial current amplitude,
I = current amplitude at time t,
f = frequency of alternating current.

54. *Decrement, Logarithmic, of an exponentially damped alternating current:* This is the logarithm of the ratio of successive current amplitudes in the same direction.

Note: *Logarithmic decrements are standard for a complete period or cycle.*

Let I_n and I_n+1 be successive current amplitudes in the same direction.
d = logarithmic decrement,

Then, $d = \log_\varepsilon \frac{I_n}{I^n+1}$, where $\varepsilon = 2.718+$.

55. *Decremeter:* An instrument for measuring the logarithmic decrement of a circuit or of a train of electromagnetic waves.

56. *Detector:* That portion of the receiving apparatus which, connected to a circuit carrying currents of radio frequency, and in conjunction with a self-contained or separate indicator, translates the radio frequency energy into a form suitabe for operation of the indicator. This translation may be effected either by the conversion of the radio frequency energy, or by means of the control of local energy by the energy received.

57. *Device, Acoustic Resonance:* A device which utilizes in its operation resonance to the audio frequency of the received signals.

58. *Diplex Reception:* The simultaneous reception of two signals by a single operating station.

59. *Diplex Transmission:* The simultaneous transmission of two signals by a single operating station.

60. *Duplex Signaling:* The simultaneous reception and transmission of signals.

61. *Excitation, Impulse:* A method of producing free alternating currents in an excited circuit in which the duration of the exciting current is short compared with the duration of the excited current.

Note: The condition of short duration implies that there can be no appreciable reaction between the circuits.

62. *Factor, Damping:* The product of the logarithmic decrement and the frequency of an exponentially damped alternating current.

Let I_o = initial amplitude.
I_t = amplitude at the time t,
ε = base of Napierian logarithms (2.718+),
a = damping factor,
Then, $I_t = I_o \varepsilon^{-at}$

63. *Factor, Form:* The form factor of a symmetrical antenna for a given wave length is the ratio of the algebraic average value of the R. M. S. currents measured at all heights to the greatest of these R. M. S. currents.

Note 1: For a given R. M. S. current at the base of the antenna, the field intensity at distant points is proportional to the form factor times the height of the antenna.

Note 2: The effective height (height of center of capacity) is equal to the form factor times the actual height of the antenna.

Note 3: The limiting values of the form factor for various types of antennas are as follows:

Linear or Vertical Antenna: Long waves—lower limit = ½, for fundamental —lower limit = 2π. Flat Top Umbrella Antenna: Long waves—upper limit = 1.

Note 4: The form factor varies in a given antenna at various wave lengths due to variation of the current distribution.

64. *Frequencies, Audio (abbreviated a. f.):* The frequencies corresponding to the normally audible vibrations. These are assumed to lie below 10,000 cycles per second.

65. *Frequencies, Radio (abbreviated r. f.):* The frequencies higher than those corresponding to the normally audible vibrations, which are generally taken as 10,000 cycles per second. See also Frequencies, Audio.

Note: It is not implied that radiation cannot be secured at lower frequencies, and the distinction from audio frequencies is merely one of definition based on convenience.

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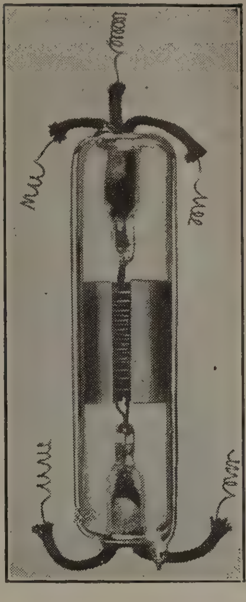

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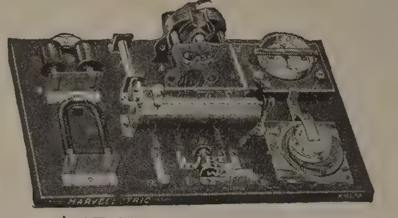

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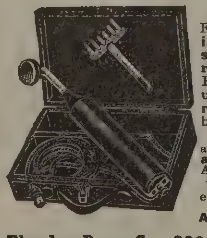

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66. *Frequency, Changer:* See Changer, Frequency.
67. *Frequency Group:* The number per second of periodic changes of amplitude or frequency of an alternating current.
    Note 1: Where there is more than one periodically recurrent change of amplitude, or frequency, there is more than one group frequency present.
    Note 2: The term "group frequency" replaces the term "spark frequency."
68. *Frequency Transformer:* See Changer, Frequency.
69. *Fundamental of an Antenna:* This is the lowest frequency of free oscillations of the unloaded antenna. (No series inductance or capacity.)
70. *Fundamental Wave Length:* The wave length corresponding to the lowest free period of any oscillator.
71. *Gap, Micrometer:* A device for protecting any apparatus from excessive potentials, and consisting of a short gap designed for fine adjustment.
72. *Ground:* A conductive connection to the earth.
73. *Height, Effective, of an Antenna:* See Factor, Form; Note 2.

ELECTRICITY NOW RIDS TREES AND PLANTS OF INSECTS.

(*Continued from page 229*)

whole area with a solution. Large conductors in the form of metallic plates are then placed in the trenches and connected to the current supply.

When the plant itself, such as a tree in an orchard, is to be treated, the solution carrying the element adapted to destroy the insects is made the electrolyte in an electric apparatus, and the plant then sprayed with the solution after decomposition has taken place through the action of the electric current.

A very simple and economic means of accomplishing this object is the following: On a vehicle is placed a tank suitable to be converted into an electric apparatus by filling it with the required electrolyte, and immersing therein two electrodes, an anode and a cathode. If preferred, the tank may be divided into two compartments. The motor power of the vehicle, if self-driven, is coupled to a generator and to the leads of the dynamo are connected two electrodes. The vehicle is moved to the tree, if an auto-truck is used, and the dynamo is started. Electric currents are sent through the electrolytic apparatus, thereby electrolyzing the solution and freeing the element adapted to destroy the insect, either in the form of a gas or in the form of a gas-bearing solution.

In the schematical arrangement shown in our illustration the truck used to carry the spraying outfit is fitted simply with an electrical motor of a small size, which drives the rotary pump for producing the spray pressure. The supply wires are also connected through a controlling rheostat to the decomposition or electrolyzing tank.

Various materials may be used for the insecticide, among them common salt or chloride of sodium. When salt is used, the electrolytic action generates chlorine in the positive compartment, or in the region of the positive electrode. This chlorine while in its gaseous state or dissolved in the liquid, is one of the most powerful insecticides known, not only for spraying plants themselves, but also for the purpose of purifying the soil in which the roots grow. In making use of the electrolytic solution, either the contents of the positive compartment alone may be used, or it may be mixed with the contents of the negative compartment, which then contains a hydrated oxide of sodium. Ammonium compounds are very well adapted for the purposes here set forth, as they not only act as an insecticide as after electrolyzation, but they also greatly enrich the soil and act substantially as a fertilizer. Of these compounds the cheap carbonate of ammonium, chloride of ammonium, or nitrate of ammonium, as well as any other sulphate may be used for the reason that the free ammonium is a germicide in itself, and yet will act when combined with moisture of the soil as a revitalizer.

The inventor mentions that the kind and strength of solution used in any case will depend naturally upon the nature of the plant or on the nature of the seed. Where this factor does not permit the application of an alkaline solution the soil may be impregnated with salts of metals, such, even, as a salt of iron or copper, the compound being afterwards electrolyzed. It is recommended that the electrolyzation be applied either in the early spring or in the late fall. A little experimenting in this direction will soon acquaint those interested in the process with such factors, as the time of application, and the kind of solution to be used. The process of course can be tried out very nicely on a small scale, even in the backyard garden, so endeared to suburbanites who are always willing to try out anything once, no matter what, that will conduce to intensive agricultural results.

Mr. Kitsee points out in conclusion that if this idea is carried out properly and carefully the most obnoxious insects, such as weevels in cotton fields, which have destroyed hundreds of thousands of dollars' worth of cotton in past years, and scale on fruit trees can be successfully destroyed. The only caution necessary is that the strength of the electrolyte shall be properly proportioned so that the root of the plant will not be injured, especially where the insects are to be treated in the soil itself.

AN EARLY POWER BATTERY.

(*Continued from page 236*)

or approximately 40,000 horse power, steadily. This seems like a vast amount of energy and it really is, but possibly a few figures on this machine as to the number of lamps it can light at one time will bring the matter out more clearly.

Figuring on 100 watt tungsten lamps of the incandescent type and with which we are all acquainted, this powerful turbo-alternator (a number of which are now in actual use for lighting thousands of lamps and driving motors in New York City) could light 300,000 such lamps; or in other words it would produce in this way roughly speaking 30,000,000 candle power. If it was used to light arc lamps, requiring about 500 watts apiece, allowing 6 such arcs to the average city block, and figuring on 20 blocks to the mile, then we could light up a street 500 miles long with a fair degree of brilliancy indeed. Such a highway would reach from New York to Detroit or from New York to Cincinnati. This will give some idea as to what such a monster dynamo of this type can accomplish. Again should we use only 3 arc lights to the block, then a road could be lighted from New York City to St. Louis. The famous Lincoln Highway intended for automobilists and running from New York to San Francisco, could be illuminated with arc lamps operated from this single machine, with the arcs divided up at the rate of 20 to the mile, which would give a much better light than that which many a highway now enjoys.

The rating of this machine compares with the total horse power required for driving the most powerful dreadnought owned by Uncle Sam, the battleship *Florida,* whose engines develop 41,240 horse power. This power is also sufficient to drive most of the large ocean greyhounds. Some idea as to the comparatively small physical dimensions of this mighty alternator can be gained from the fact that it stands only about 15 feet above the floor and the length over all does not much exceed 40 feet.

PATENT ADVICE

Edited by H. GERNSBACK

In this Department we will publish such matter as is of interest to inventors and particularly to those who are in doubt as to certain Patent Phases. Questions addressed to "Patent Advice" cannot be answered by mail. Sketches and descriptions must be clear and explicit. Only one side of sheet should be written on. No attention given to unsigned communications.

PHONE SYSTEM.

(81.) Charles C. Craig, Colo., submits a description of a novel 'phone system to work over a barbed wire fence line. He claims he is using this system himself with good results and wishes to know if such an idea is patentable and whether it would be a commercial success.

Schemes of this kind are only makeshifts at best and have no commercial practicability. We doubt whether a patent could be obtained on it.

VARYING INDUCTANCE.

(82.) Edward Rutledge, Anchorage, Ky., submits a scheme whereby it would be possible to tune a *loose coupler secondary* without the use of switches. Our correspondent employs a damping device in the form of a metal sheet. He wishes to know whether a device of this kind would work satisfactorily and if a patent could be obtained on it.

While there is no doubt that a device of this sort will work in a fair manner, we do not believe it would be good for all around work. It seems as though the metallic sheet would cause too much damping. Neither do we think that a patent could be obtained upon this idea, inasmuch as several devices of this kind have been tried before.

RAILWAY BRAKE.

(83.) B. C. Batson, Wiggins, Miss., submits drawings and description of a railway brake which is supposed to work by inserting a wedge-shaped body between the wheel and the track. He wishes to know if an idea of this kind is patentable.

A patent might possibly be obtained on this invention but we do not think that the device is practical at all, as the wedge would tend to derail the car invariably. We do not think that any railroad would consider the adoption of such a brake.

RADIO TIKKER.

(84.) L. A. George, Syracuse, N.Y., wants to know if it is possible to obtain a patent on any kind of a tikker. For instance, a design consisting of a small gear wheel operated by a variable speed motor. If not, is one within his rights to manufacture a tikker and put it on the market?

Valdemar Poulsen has a patent on the tikker and we do not think it is possible for this reason to obtain a patent now. Any device, even if it is not patented, providing it has been used before or described before in any public print, is not patentable. It might, however, be possible for you to devise some modification of the *Poulsen Tikker* which would not infringe upon his original patent, and you could of course then put it on the market. However, with no patent protection, anyone else who so desires may copy and market the device.

ADVERTISING DEVICE.

(85.) James P. Lewis, of Golden, Colo., submits a sketch of an advertising novelty which he calls an *Electric Rainbow* device. He wants to know whether an idea of this kind can be patented, and further, if it would be worth his while to put it on the market.

The idea appears to us to be a very good one and we have no doubt that a patent could be obtained on a device of this kind. Nearly every advertising device which involves a moving element with numerous colors, is generally a very good commercial proposition and there is usually a good market for such inventions. We would advise our correspondent to get in touch with a patent attorney on this idea.

CREAM SEPARATOR.

(86.) R. C. Requa, of Cold Spring Harbor, L. I., N. Y., submits an illustration and description of a cream and milk separator and wishes to have our advice on same. The device is made in such a manner that it fits on top of any milk bottle.

The idea is a very good one but we doubt if a patent could be obtained upon it. There is, of course, nothing new exemplified in this attachment except that a sort of pump is used to draw off the milk from the cream. While the idea is novel it is doubtful whether on a device of this sort a patent could be obtained, for the reason that the mechanism involved in the invention is not new.

CONTINUOUS PAPER BAG.

(87.) Samuel English, New York, has conceived of an idea whereby it is possible to roll up a series of paper bags, made in a special manner, upon a cylinder. The bags can be detached one by one, by virtue of perforations at the end of the closed side, the idea being to use the bag in a similar way to ordinary wrapping paper. In other words, the bags would not be lying around

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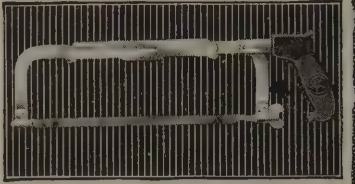

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loose, which is the case now, each one being detached from the roll as required.

The idea is an excellent one and we believe it is thoroughly novel. The arrangement of folding the paper is also a new one and we think there should be little trouble in securing a valuable patent on this invention. We would advise our correspondent to get in touch with a patent attorney.

Our correspondent furthermore submits a device whereby a pencil can be held by means of a hair pin; such a device to be used by sales-ladies, who at the present time have a habit of sticking their pencils in their hair, which is both unsanitary and dangerous, especially in the case of indelible pencils.

This idea, while thoroughly feasible and patentable, is not of commercial practicability, we believe, because it is rather unaesthetic. Customers, we imagine, would not like to see hairpins stuck on pencils, right in front of them.

PATENT PENDING.

(88.) J. Shenkel, of Cleveland, Ohio, writes as follows:

"There is a certain device on the market with *Patent Pending* stamped on it, and for many reasons it is imperfect. I have an idea which contains not only all of the features incorporated in this article, but several marked improvements, making the device much more perfect and saleable. Can I obtain a patent on my idea? If not, what should I do with it?"

Without seeing the original device and the improvement thereon, it is absolutely impossible to tell offhand whether you would be infringing on the other invention or not. Just because an article is stamped *Patent Pending,* does not mean anything whatsoever, although it gives due notice that a patent has been applied for in most cases. This, however, is all; the patent in question may never issue and even if a patent is obtained, there is no proof that the device is practicable. If you think that your improvement does not infringe upon the other idea we think it would be safe to apply for a patent. Without knowing all the details, however, there is a chance that there might be an interference proceeding in the patent office and we think you had better take up the matter with your patent attorney for his advice, submitting the original, as well as your idea.

Our navy needs wireless operators and electricians. The advancement in this branch of the service is more rapid than in any other. All men who enlist for this work are sent to the navy school for six months and are paid while under instruction.

An electric meter is still in continuous use by the New York Edison Company which was installed in 1896. Previous to this installation the old chemical deposition meters were used.

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MEETING OF THE INSTITUTE OF RADIO ENGINEERS.

Two papers were presented at the April meeting of the Institute, one on the Chaffee quenched arc, by Mr. Bowden Washington, and a paper on tests made at the Darien station, by Dr. Austin.

Mr. Washington, who is connected with the manufacture of the Chaffee arc, was well equipped with facts concerning the adaptability of the gap for use in the portable and aeroplane sets. An outfit has already been marketed which, with an input of ¼ K.W., will transmit fifty miles. The complete equipment weighs only fifty-six pounds. For driving the generator, a fan, driven by wind pressure is used.

The gap itself is composed of two aluminum electrodes, in an aluminum chamber. Moist hydrogen is supplied from a small tank to the arc chamber. The action of this gap is not thoroly understood; it has marked quenching characteristics, however, which give the set a considerable transmitting range, altho the efficiency of the complete set is not particularly high. Almost all the apparatus is constructed of aluminum. This is an important point where weight is a consideration.

In his paper on the Darien station, Dr. Austin described the trouble encountered from the static electricity. He also spoke of the comparative tests made with the electrolytic audion, and audion amplifier detectors, used at different times during the year. The method of measuring amplification of signals was the usual one, employing a resistance, shunted across the 'phones. Dr. Austin pointed out the recognized need of a circuit to cut down the static strays, which, he found, were amplified as much as the signals by the audion.

Dr. de Forest, when called upon to give his opinion concerning the accuracy of amplification measurements stated that, according to his experience, the usual method was satisfactory up to an amplification of 500 or even 1000 times. "Above that," he added, "we should have a new unit. I would suggest we call this unit a *hellofanoise!"*

In a further discussion by Dr. Zenneck, Mr. Armsrong, Mr. Clark, and other radio engineers, several interesting points were brought out. It was stated that the usual amplification per step is five to ten; with regenerating circuits, 500 to 1000 times. A circuit for receiving undamped waves by the beat method was discussed. It consisted simply of a small inductance coil in the secondary circuit of a loose coupler. Coupled to the small coil was another inductance, with a capacity in shunt. When properly tuned, this circuit will generate beats in the detector circuit. Dr. Zenneck spoke of the errors in amplification measurements. He stated that when a shunt resistance and 'phones are used, only the alternating current component is measured, and the less the inertia of the detector element, the greater the alternating current component. In beat and regenerating circuits, it is impossible to measure the strength of the incoming signals, since energy is generated in the receiving apparatus itself. In such sets, only a comparative determination can be made. Audible signals used in these tests are those from which dots and dashes can be distinguished.

At the May meeting of the Institute, Prof. A. E. Kennelly, and Mr. H. A. Affel, presented a paper on, "Skin Effect Resistance Measurements of Conductors at Radio Frequencies."

The smallest commercial electric motor weighs less than two pounds. It is useful where little power is required, such as for dental drills.

WAR NO EXCUSE FOR NOT SELLING "TUCKERTON" STATION.

The Court of Errors recently upheld Vice Chancellor Stevens's decision declaring that, because a state of war exists between France and Germany, is no reason why a contract entered into prior to the war, by a German company to sell the Tuckerton, N.J., wireless station and its patents to a French concern should not be consummated.

The suit was commenced by the Compagnie Universelle Télégraphie et de Téléphonie Sans Fil to compel the United States Service Corporation, Hoch Frequenz Machinen Aktiengesellschaft für Drahtlose Telegraphie, Rudolph Goldschmidt and Emil Mayer to perform their contract made in Paris in 1912, by which the German company was to sell the station and patents to the French concern.

MARVELS OF MODERN PHYSICS.

(*Continued from page 247*)

attached to the negative pole, otherwise an ugly permanent scar will result from the corrosive action of the acids on the needle, and the coagulation of albumin in the tissues.

Probably the most important general action of the galvanic current is due to the fact that all congestions or inflammations, acute or chronic, are attended by an undue centralization of alkalies, and dilation of the blood vessels. All pain is also caused or accompanied by similar conditions. This indicates, of course, the use of the positive pole to produce relief, while sub-normal conditions indicate the use of the negative pole. In order to concentrate the effect of any one pole, a large and small electrode may be used as shown in Fig. 3. It will be seen that the greatest concentration is at the smaller electrode, and the local effect at the other electrode is comparatively negligible.

Many electrical appliances are of inestimable value to the surgeon and physician. A simple electro-magnet with a pointed tip is shown in Fig. 4, which is extremely useful in removing metallic particles from the eye. The surgeon uses small platinum knives and points heated by electricity in all forms of cautery work. Ozone, which is produced by a spark discharge, is most valuable in treating pulmonary diseases, such as tuberculosis and pneumonia, and in cases of shock and unconsciousness.

Of the many diseases treated by electricity, the results in a number of instances are of doubtful value, and in very few cases does the electrical treatment take the place of other remedial agencies. Any good results at all, however, are heartily worth while, and many positive cures have been effected.

A new study has developed recently in the application of radiant light to medical work. This is known as photo-therapy. Many very common facts prove to us the influence light has upon the tissues. Light is one of the essentials of life. For therapeutic purposes the spectrum may be divided into three parts: (1) the heating portion composed of red, and infra-red rays, (2) the luminous consisting of the yellow and green rays, and (3) the chemical or actinic composed of the blue and violet rays.

Finsen, a Danish scientist, devised a means of using ultra-violet light in treating diseases of the skin. He used a strong electric arc to produce violet rays, or *Finsen rays*, as they are called, and focussed these upon the affected part. Ultra-violet rays possess great germicidal properties and have been used experimentally to sterilize milk, water and other liquids. Owing to the fact that the rays do not penetrate to any great depth, a mechanical difficulty is met with in using this method in actual practice. Tubercle and typhus bacilli are killed after a short exposure to these rays, and on the continent of Europe the treatment is very extensively used in connection with *lupus*, a common skin disease of that part of the world. Many improvements have been made on the original method, and numerous other lamps are in use such as the Minin lamp, invented by Professor Minin of Petrograd, which, it is claimed, gives better results than the Finsen rays. The Helios and Russian lamps are similar in nature but of modified characteristics.

Upon the discovery of X-rays and radio-activity it was believed that another great curative agency had been discovered. As in the case of electricity, predictions were extravagant and multitudinous; however, as might be expected from agencies possessing such important characteristics, they are continually finding more room for application, and are continually proving more and more their value. Although it was originally thought that a positive cure had been found in them for tumors and cancerous growths, time and experience has tempered our enthusiasm, and we now know that only in certain cases are cures effected. In the early stages of such a disease its progress may be arrested but certainly in the later stages it is seldom that anything can be done.

In the use of X-rays great care must be taken to avoid burns. The rays which are absorbed by the skin, if the exposure is excessive, may themselves cause a *cancerous ulceration* which eats deeper and deeper, and *for which there is no known cure*. In the early history of X-rays several scientists found this out at the cost of their lives, but means are now provided for shielding both the operator and patient by the use of sheet lead and lead glass.

Strangely enough the X-rays seem to have very little germicidal action such as the ultra-violet rays evince. Their therapeutic action is most likely due to the small particles of matter or corpuscular rays thrown off when they are absorbed.

It was found also in a rather painful manner that radium rays will cause a burn similar to that of X-rays. Becquerel, the famous scientist, who was experimenting with radio-active substances, carried a small tube of radium preparation in his vest pocket for six hours, and a few days later an inflammation set in which developed into an ulcer of the abdomen, requiring months to heal. On the other hand, if used properly, skin diseases and surface cancers may be successfully treated by it, as by X-rays. Dr. MacKenzie does not believe radium is much more valuable than X-rays, but reports that by its means he has cured rodent ulcer, tuberculosis, verucca, cutitis, rodent cancer, and removed moles. Although cancer, one of our modern plagues, is very little understood, it seems very doubtful if radium will offer a cure, especially when the disease is deep-seated.

Such wonderful properties as these possessed by electricity, light, and radio-active substances, promise much for the future, when we have better learned to control and utilize these natural forces. At present what has already been done in alleviating the sufferings of the sick, and exterminating disease is immensely worth while, and shows the broad field which is open to the physicist as well as to others in the scientific world.

[*This is the seventh paper of a series prepared especially for* The Electrical Experimenter *by Mr. Rusk.—Editor.*]

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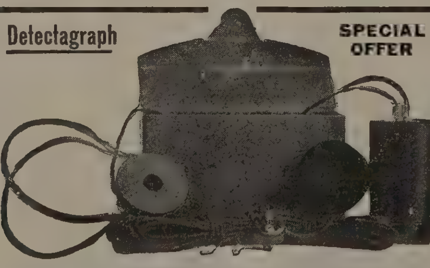

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THE VACUUM DETECTOR AND HOW IT WORKS.

(*Continued from page 250*)

grid, the wing current will always be *reduced* momentarily, or as long as the potential is applied.

Mr. Armstrong accounts for this action as follows:

An incoming wave train sets up oscillations in the closed circuit S-VC. These are then rectified by the valve action of the hot filament and the cold grid within the evacuated bulb, and the rectified current is used to charge the condenser, SC, in the manner previously explained. The electrons (negative electric charges) emitted by the hot filament readily pass into the wire grid, mounted between the filament and wing, but cannot easily escape. In consequence a negative charge is built up on the side of the condenser, SC, which is connected to the grid. The negative charge thus imparted to the grid scatters the stream of electrons between the filament and wing, which, in turn, means a lower conductivity for this path between the two electrodes. The result is that the wing and telephone current are reduced.

At the end of a wave train the charge in the condenser, SC, gradually leaks off and the wing current returns to its normal value. Thus the condenser charges and discharges as each wave train arrives.

Dr. Bergen Davis of Columbia University points out, however, that the fundamental detecting action is not that of a valve, because the high frequency incoming oscillations cannot be rectified between the filament and grid, particularly as the small condenser in the grid circuit makes true "rectification" impossible, except for the exceedingly brief period while this condenser is being charged. True rectification obviously requires that a D.C. instrument in the circuit shall show a deflection, indicating a rectified or pulsating current, which is entirely absent in the grid circuit. Moreover, it has been proven by Dr. de Forest that if the grid itself is incandescent the detector action is unaffected. The grid, however, does exert a relay or trigger action on the wing current and reduces it by a disproportionately great degree.

Off-hand it may not seem to the uninitiated that any particular advantage accrues with this instrument, but it should be remembered that when the grid effect takes place at each signal, the corresponding amount of current controlled secondarily, and flowing through the high voltage 'phone circuit, T-B$_2$, etc., is many times that flowing in the filament-grid circuit.

Considering Fig. 2 in conjunction with Fig. 1, we have a common form of audion amplifier, of the two-stage type. This circuit yields remarkable amplifying effects. With such a circuit the pulsating current in the 'phone circuit of valve No. 1, passes through a high resistance iron-core impedance, IMP. When this pulsating current passes through the impedance coil there is a tendency for it to be converted into an alternating current, owing to the lagging effect of the iron core. However, the current flowing in the filament-grid circuit of Audion No. 2 is amplified in the same manner as described for Audion No. 1, and amplified charges pass from the filament of Audion No. 2 to the grid. Thus the grid becomes alternately negatively and positively charged and likewise the condenser plate to which it is connected. This Audion then works in the same manner as Audion No. 1, so as to greatly increase the fluctuations in the telephone receiver current from battery B$_3$. In other words it will readily be seen that a very strong amplifying effect takes place in the two detectors, as the current passing through the impedance coil in the secondary circuit of the first bulb is very strong. This comparatively strong current is then used as a *trigger* or control current for Audion No. 2. Since this current in question is many times stronger than the *trigger* current, as in the case of Audion No. 1, it is evident that an extraordinary current change will occur in the 'phone circuit of Audion No. 2.

MODERN RADIO RECEIVING APPARATUS.

(*Continued from page 252*)

lated by means of a six-point switch, just above the condenser. The filament battery switch is located in the upper left hand corner. This method of generating the undamped oscillations is the most flexible one yet devised and permits a rapid change of frequency, which is very steady and constant.

There is still another method of exciting the receiving apparatus with sustained oscillations, viz., by employing a high frequency buzzer. However, the other methods described are better for commercial work.

The inductive coupler was for many years an inefficient instrument in the radio receiver, due principally to improper design on the part of the radio engineer. As the art advanced the design and working qualities of some of the commercial type of couplers also improved. In Fig. 6 the latest type of loose coupled tuner is illustrated. It is one of the best ever designed as it embodies several important and unique improvements over the older ones.

The primary coil is of pancake form and so constructed that the windings offer the least possible distributed capacity. The value of its inductance is varied by a multi-point switch. The complete unit is supported on two circular rods, which allow it to be moved in or away from the stationary secondary coil. This is radically different from the old types employing a movable secondary coil, and stationary primary. The secondary is made in a similar manner to the primary. Its inductance is also controlled by a multi-point switch, located at the right of the cabinet.

A loading coil is provided inside of the cabinet for higher wave lengths, being controlled by a rotary knob on the top of the instrument. Binding posts are provided for connecting the coupler to the auxiliary necessary apparatus. A very unique but still important feature of this tuner is that when tuning the primary inductance, the coupling primary and secondary are varied at the same time. This saves time on the part of the operator in performing two functions which can be done with one operation.

This article and the one previously published, describing *Modern Radio Transmitting Apparatus*, will undoubtedly prove of benefit to those who are following up the commercial end of radio telegraphy. *Photos courtesy of National Electric Signaling Company.*

RADIO LINES DOWN.

It will never do for radio telegraph companies to notify the public that business will be accepted subject to delay because "the wires are down," yet such an event happened during the late, or rather the latest, storm at Sayville, L.I., when the antenna of the station at that point was brought down to earth by the weight of sleet.

The time may come when the wireless companies will have to maintain a squad of aeroplane linemen, whose duty it shall be to look for kinks in the air. What?

LONG DISTANCE RECEIVING WITH AUDION HETERODYNE.

(*Continued from page 255*)

M of the audion. Through the mutual inductance of M_1, energy is handed back from the wing circuit to the grid circuit P_1SC_2, thus reinforcing the oscillations therein. When the coupling at M_1 is properly adjusted, energy is returned to the grid circuit at such a rate as to maintain the oscillations of that circuit at constant amplitude. Thus the receiving circuits are the seat of *sustained* oscillations of radio frequency which are, of course, perfectly inaudible when acting alone in the circuit. The frequency is controlled by the local values of capacity and inductance.

The circuit in Fig. 1 acts in very much the same way as this, except that the coupling between the wing and grid circuits is an electrostatic one through the condenser C_4, instead of through the transformer M_1 of Fig. 4.

It is not at all necessary to have the local oscillations produced by that incoming on the aerial as just described. In fact, the local oscillation will, and usually does, start whenever the current in the wing circuit, and hence that through the coil S_1 of the grid wing-circuit coupler, is changed, as for instance, when the switch in this circuit is closed or even when some metal part of the circuit is touched by the hand of the operator.

In handling these circuits a most interesting feature is the pronounced freedom from interference and the ease with which two sustained wave stations using almost identical wave lengths can be separated. For instance, suppose two stations are sending at the same time—one with a frequency of 50,000 cycles, and the other with a frequency of 50,500, that is, their wave lengths differ by only 1 per cent. If these stations were of the spark type, radiating trains of damped waves, it would be practically impossible to prevent one from interfering with the other at a receiver, unless one happened to be very weak. But in the case of sustained waves and beat reception even though the interfering station, say the 50,000 cycle station, is many times as strong as that whose signals are wanted (in this case that using 50,500 cycles), it is perfectly easy to eliminate the interfering station and read the other. All that is necessary is to change one of the receiving condensers, e. g., C_2, so that the local oscillation frequency equals 50,000. Then the interfering station, that using 50,000 cycles, becomes perfectly inaudible, since its beat frequency is now zero; the other station, however, using 50,500 cycles is still clearly heard with a musical note corresponding to the beat frequency—500 cycles. This method of suppressing the signals of interfering stations is very useful but, of course, not possible in any ordinary reception of spark stations.

Shortly after installing the above apparatus the writer began to listen for signals from the high power European stations situated at Nauen and Hanover in Germany. The station at Hanover was reported to be in communication with the corresponding station in the United States located at Tuckerton, N.J. The Nauen station communicates with Sayville, L.I. Both Nauen, POZ, and Hanover, OUI, are now received nearly every day after 10 a.m. and on into the night. The intensity varies considerably from day to day and even from hour to hour, especially around the sunset period, but averages about 10 with the audion now in use.* The most satisfactory reception is had from 4 to 6 p.m. since after dark the strays (static) frequently become so severe as to make the reading of weak signals very difficult.

These stations are about 4,700 miles from St. Louis, and inasmuch as signals are received in broad daylight, and especially since the aerial at this station is rather small for receiving the enormous wave lengths of these stations, it is seen that the heterodyne or beat system of receiving is extraordinarily sensitive.

In view of the fact that reception by the beat method depends upon *detuning* the receiving circuits, i.e., adjustment to frequencies slightly different from that being received, and that for best results at a receiver the circuits thereof should be tuned accurately to the incoming wave, it occurred to the writer to see to just what extent the detuning could be carried without materially affecting the strength of signal. Sayville, using a 9,400 meter wave, was chosen for observation. At this wave length the frequency of the incoming oscillation is 32,000 per second. 1% deviation from perfect tuning will, therefore, give a beat pitch of 320 per second; 2%—640; 5%—1,600. Between 1% and 3% asynchronism the loss in energy due to detuning seems to be negligible; at 5% there is a very decided loss. It seems best, therefore, to keep the beat pitch for stations of long wave length rather low.

Sayville's transmitter is of the Joly type, which depends for its action upon the use of critical magnetic saturation in the cores of transformers in such a way as to double the frequency. Energy is radiated continuously at a constant wave length but is limited by the transmitting key, when this is not making the dots and dashes. The signals from this station come in with a continuous, uniformly pitched note, the dots and dashes being made apparent simply by increments in the intensity of the note.

In this respect Sayville's signals resemble those of the German station at Hanover, OUI, and Tuckerton, N.J., call letters WGG. Both of these stations use the Goldschmidt reflecting alternator and signals are transmitted by alternately weakening and strengthening the field excitation of the machines. The note produced is very pure, and like the Sayville station is peculiar in that it is heard continuously between the dots and dashes. It is to be noted that the Goldschmidt equipments give a slight variation or swinging in the beat pitch, which is probably due to the slight variations in the speed of the alternators. This is not, however, of sufficient magnitude to produce any annoyance, since the beat pitch swings very slowly and can easily be corrected by a little attention to the receiving condenser.

Somewhat different features attend the reception of stations using sustained wave transmitters of the arc type, such as Arlington, NAA, Charleston Navy Yard, NAO, New Orleans, NAT, and Darien, Panama, NBA. These stations signal by slightly changing the length of the emitted wave. Thus, two waves are radiated alternately, one the *signaling* wave, forming dots and dashes, and the other, the *compensating* wave which is radiated in the intervals between the dots and dashes. These waves only differ by 2% to 5%, and both are therefore heard in receiving. However, the beat pitch of each is different, one forming a high note while the other is usually much lower, and thus it is perfectly easy to mentally separate the signals from the compensating wave. It is frequently possible to completely suppress the compensating wave by tuning the receiver so that its beat frequency drops to zero. The signaling wave is then the only one heard and though it now has a rather exaggerated pitch, it is generally very easy to read.

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*This audion is not a particularly good one for maintained wave reception.

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The oscillating audion is, of course, effective also on damped oscillations, especially if we deal with long, feebly damped waves as for instance those of the trans-Pacific Marconi station at Bolinas, Cal., K E T, at about 7,000 meters. This station can be received at any time during the afternoon or evening and communicates with the Hawaiian Islands. The note is quite clear, but is, nevertheless, typical of a spark station and nothing like the clear flute-like note obtained when the oscillating audion is used in receiving continuous waves.

When the oscillating audion adjustment is made for K E T, the signals become exceedingly hoarse and rough, completely losing their tone quality but gaining tremendously in intensity. The same is true of Arlington's spark set at 2,500 meters; but the readability of the signals has not, in the opinion of the writer, been very materially increased owing to the loss of their musical quality.

The sustained wave received with the greatest intensity at this station is Tuckerton, W G G, sending usually at about 8,500 meters. This station is frequently so loud in the evening as to be heard 20 feet from the telephones. This is when the Goldschmidt alternator is used. The arc set of this station, using two waves, has never been as strong as that of Arlington on the 7,000 meter wave. Arlington's signal has frequently been measured at *5,000 times audibility*, and is so strong as to be actually painful to the ears.

Incidentally, an interesting example is here afforded of the possibilities of resonance when using the audion heterodyne in the reception of sustained waves. It will be understood, of course, that in order to obtain any considerable transfer of energy at the loose coupler, it is necessary to have both primary and secondary circuits adjusted very closely to resonance. Moreover, the coupling must be made rather tight if the waves arriving on the antenna are damped. The less the damping the looser can the coupling be made. Loose coupling is desirable because it very greatly reduces interference from unwanted stations as well as from static. With the new heterodyne receiver and undamped waves it has been possible to *separate the primary and secondary of the loose coupler by as much as 12 feet and still keep signals at readable strength.* At this distance the mutual inductance of the coils is exceedingly small indeed, and the selectivity is almost perfect. Static, which with the ordinary values of coupling, comes in like the rattle of musketry and strong enough to temporarily paralyze the audion, is only occasionally audible with this weak coupling. There is, of course, a considerable loss in signal strength with this low value of mutual inductance, but it has been possible in this way to read all of the stations in this country using sustained waves as well as the Darien station in Panama, when it was impossible to keep the audion in adjustment at the ordinary coupling on account of the heavy static. It is necessary, however, to keep the circuits very closely tuned to the incoming wave-frequency, and for this reason the beat pitch is always low with very loose coupling. It is hardly necessary to point out that such exaggerated values of loose coupling are out of the question with the ordinary audion receiver and damped waves.

It may be of interest to state that all of the stations on this continent received on the regular aerial, even including N A W, Guantanamo Bay, Cuba, have also been received on a grounded aerial consisting of a single No. 26 wire laid along the surface of the earth and carried about 750 feet in a southwesterly direction from the station. Signals received on this antenna have an average audibility one-fourth of those received on the regular antenna. The regular antenna has an effective height of 90 feet and consists of eight wires 300 feet long. Its capacity is 0.0018 mf. and its natural period 610 meters.

It is evident from these experiments that the oscillating audion reception of continuous waves is an exceedingly efficient one, first, because of the almost complete freedom from interference; second, because of the considerable amplification obtained even with a single bulb; and third, because the musical quality of the received signals is absolutely perfect. Moreover, the pitch is always under the immediate control of the receiving operator.

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After more than a year of experiments and tests, the Select-o-phone has been put on the electrical market. This instrument is an automatic telephone for factories, which requires no manually operated switchboard.

Three wires run to each telephone from the central station. At the bottom of the switchboard all the terminals are connected. The upper part contains the selectors, operated automatically by the dial on each telephone. The system is built upon the unit basis, so that if one circuit breaks down it will not affect any other circuit. Moreover, the installation is so greatly simplified that the factory electrician can keep it in running order.

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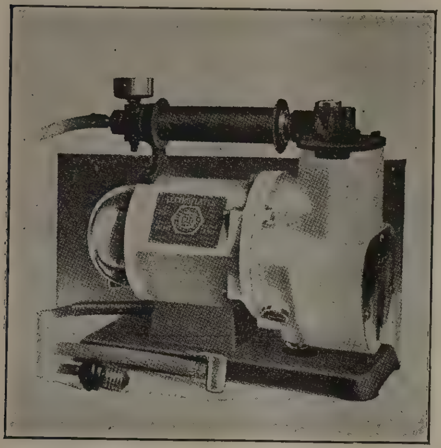

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A new automobile searchlight has recently been placed on the market by a Pittsburgh concern. The shell of this searchlight consists of a single spinning and it is consequently very light in weight, the total including bracket being only 1½ pounds. The construction of the lamp permits the use of any automobile lamp made, regardless of style, size or voltage. Consequently it can be made to give either a very powerful light or one of less brilliancy, according to the owner's wishes. The searchlight is easily opened for changing bulbs and the focusing is accomplished by loosening an exterior set screw. The diameter of the lamp is five inches.

Efficient Electric Auto Lamp.

One of this line of lamps can also be used with horse drawn vehicles since on account of its construction it can be used satisfactorily with ordinary dry cell batteries.

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WATER WHEEL DRIVES FOR PRIVATE LIGHTING PLANTS.

(*Continued from page 259*)

conversely the amount of light which can be produced by a given current.

In deciding upon the number of lamps required to light a certain area or building, it is a good approximate rule to figure on one 16 candle-power lamp to every 100 square feet of floor space, in rooms where the walls are light; one and one-half to two times this candle-power should be figured on for rooms with fairly dark ceilings and side walls.

It is beyond the scope of this article to give all the various details covering the methods of wiring for electric lights and motors, etc., but it should be borne in mind that if the system operates at a potential of more than 10 volts, the wiring should be installed in accordance with the Fire Underwriter's rules, a copy of which may be obtained by writing to the Board of Fire Underwriters, 123 William Street, New York City. Rubber covered wire is recommended in general for the wiring. Porcelain cleats or knobs may be used to support the wires, and the wires should be well spaced in all cases unless they are covered with circular loom insulation. Where the wires pass through any partitions or floors, porcelain tubes should be used. In running outside lines such as those extending from the power station to the house or barn, the wires can all be supported on trees or poles by standard size glass or porcelain insulators, which can be obtained from any electrical supply dealer. For tree supports the insulators may be mounted on wooden pin brackets nailed to the limbs. Trim off all branches in close proximity to the wires.

We will now consider some of the basic laws governing the size of wire to be used for a given transmission circuit. Let us assume in the following three concrete examples, that ½ K.W. or 500 watts of energy is to be transmitted from the dynamo building to a given point, 100 feet distant. Let us also assume the volts lost in the line at 5% of the line potential.

As our first example we shall consider that the 500 watts of energy are to be transmitted from a 10 volt dynamo. The current is, in this case, 50 amperes. The simplest way in which to figure the size of wire required is to compute the resistance of the two wires forming the circuit, or, in other words, the resistance of 200 feet of wire, in this instance. This resistance R is found by dividing the volts drop in a line by the current passing through it. Five per cent. of 10 volts is .5 volt. Dividing the drop, .5 volt, by 50 gives us .01 ohm. The resistance of 200 feet of the required size of wire multiplied by 5 gives us .05 ohm per thousand feet. Consulting

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the B. and S. wire table, as given in any electrical catalog or text book, we find this equivalent to No. 0000 wire. This is very large, of course, and would be expensive at the present market price of copper, the weight per thousand of this size conductor being 640.5 lbs.

Now let us consider that this same amount of energy, 500 watts, is to be transmitted from a 30 volt dynamo. Here the current will be 16.66 amperes; 5% drop in the line will be 1.5 volts. Dividing this by the current gives us .09 ohm per 200 feet of wire required for the circuit. This is at the rate of .45 ohm per 1000 feet. Looking up our wire table, No. 6 is found to be the nearest equivalent conductor for this resistance, with a weight of 79.46 lbs. per thousand feet. All of the weights here cited are for bare wire. Note that much less copper is required to transmit the same amount of energy with the higher voltage.

To demonstrate still further the marked advantages of high voltage in transmission with regard to the amount of copper required, especially let us consider this from the standpoint of 110 volts as the line potential. The current in this instance will be 4.54 amperes and 5% drop is 5.5 volts. Dividing this by the current or 4.54 gives 1.21 ohm per 200 feet of wire. This is equivalent to a resistance of 6.05 ohms per thousand feet, and according to the standard copper wire table, No. 17 B. and S. wire would carry current this distance with the loss in voltage specified. However, No. 14 copper wire should be used as this is the minimum size specified in any case by the Fire Underwriter's rules for a circuit of this character, and besides, it will stand the mechanical stress, etc., much better. Compared to the weights of copper required in the first two examples, we find that No. 14 wire only weighs 12.43 lbs. per thousand feet. Moreover, by using this approved size of wire we gain markedly in the efficiency of transmission. The resistance of No. 14 B. and S. copper wire for 200 feet is .505 ohm. The current or 4.54 yielding 2.292 volts loss, the lamps at the end of this circuit would receive very nearly 110 volts, or to be exact 107.08 volts. It is common in house wiring and ordinary circuit runs, such as those here considered, to figure on a voltage drop of 3 to 5 volts.

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By use of the ampere-feet table* given here, the size of wire may be easily selected for various voltage losses and circuit runs. To use this table it is only necessary to multiply the amperes of current in the circuit by the length of the circuit in feet, one way, giving as a product the *ampere-feet.* Suppose, for instance, that we desire to find the size of wire required for a circuit having a value of 970 ampere-feet with two volts lost in the line. In the column headed *Volts Lost—2,* we find 970 to be opposite No. 10 B. & S. gauge. This is the proper size of wire to use. The carrying capacity in amperes for rubber insulated conductors, as approved by the Fire Underwriter's rules, is cited in the left-hand column, and even though a smaller size of wire than that required by this capacity rating is found suitable, the larger wire must be used.

A diagram is given in Fig. 2 showing the usual connections for a shunt wound D.C. dynamo with field regulator, F.R., together with voltmeter, ammeter and the necessary circuits. The volt and ammeter, also the field rheostat and switch, should be mounted on a suitable switchboard as indicated in Part I of this article. For low voltages, a wooden switchboard may be used, and for potentials not exceeding 500 volts slate is satisfactory and commonly employed for this purpose. Marble, however, is the best for switchboard construction. The outgoing circuits from the dynamo building are usually controlled by switches on the switchboard. It is best in every case to have fuses on all switches to protect the dynamo from short-circuits or overloads. The individual lamps may be turned on and off by the key switches in their sockets, and when desired, individual lamps and small motors may be controlled by a switch placed at any point desired, as the diagram shows.

Where it is not desirable to run the plant at night it is a common practice to charge a storage battery during the day, from which current can be drawn for lighting the lamps. Also, in some cases, the drive may not be sufficiently steady between water wheel and dynamo, which will result in a slight flickering of the lamps. The usual electrical method of overcoming this trouble is to connect or *float* a storage battery across the main line, as shown in Fig. 2.

(The End)

LOSSES IN THE CARBON ARC.

In a paper entitled "The Consumption of Carbon in the Electric Arc," read before the British Royal Society, Professor W. G. Duffield described experiments to determine the amount of material lost by the poles of a direct-current carbon arc under different conditions of current and arc length. For a given current the carbon consumption of both the anode and the cathode increases with the arc length until a constant value is reached. Using long arcs the consumption per coulomb decreases with increasing current; the ratio of anode to cathode consumption is about 1.5, increasing slightly with the current. The author also concluded that the loss of an atom of carbon from the cathode of a very short carbon arc is accompanied by the transfer between the poles of a quantity of electricity equivalent to four electronic charges, and that in long arcs the loss is due to this essential carbon disappearance plus a quantity due to combustion. Though the phenomenon is describable on the basis of electrolytic action in which carbon is quadrivalent, the electronic emission has to be accounted for. The chief supply of cathodic material comes from behind the small growth which forms upon its extremity, but if the necessary quantity of carbon cannot be derived from this source the growth itself is consumed. The mean spherical candlepower increases with current strength and arc length in much the same way as the total consumption of carbon does. In a typical experiment the energy of combustion was approximately 11 per cent of the electrical energy supplied to the arc.

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*For further dietails in this direction and larger tables see "Standard Wiring for Electric Light and Power" by Cushing.

BARE GROUNDED RETURN WIRING SYSTEM TO BE INVESTIGATED.

The Committee on Electric Wiring Systems of The Electrical Industry has appointed the following subcommittee to investigate bare grounded return wiring systems:

Chairman, C. E. Corrigan, Associated Manufacturers of Electrical Supplies, Pittsburgh, Pa.; W. H. Flandreau, International Association of Municipal Electricians, Mt. Vernon, N.Y.; J. C. Forsyth, American Institute of Electrical Engineers, New York, N.Y.; G. S. Lawler, Associated Factory Mutual Fire Insurance Companies, Boston, Mass.; C. Renshaw, Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa.; Secretary, Wm. S. Boyd, Western Association of Electrical Inspectors, 175 W. Jackson Boulevard, Chicago.

The committee desires the co-operation of the entire electrical industry in this work, and to that end requests that all information and data on wiring systems having a bare grounded conductor to be sent to the secretary.

The committee will especially appreciate the following information:

(1) Safety, cost and reliability data based upon practical experience with concentric wiring, or any other type of wiring having one or more bare or partially covered conductors which are permanently connected to earth;

(2) Theoretical or tested installation details or protective features which will safeguard concentric wiring or other wiring systems having bare grounded conductors;

(3) Reliable methods of preventing meter setters or linemen from reversing the polarites of a two-wire system;

(4) A suitable definition of "ground" or "earth" as these words relate to electric wiring;

(5) Practical experience with ground or earth connections;

(a) Whether they have been found reliable, or unreliable;

(b) The proportion found to be unreliable, if any;

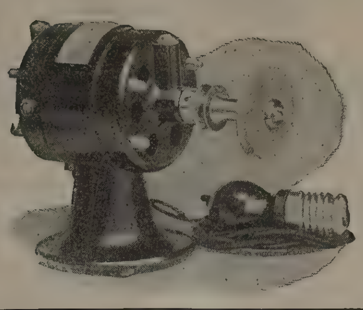
(6) Adequate methods of establishing and maintaining a reliable ground or earth connection for safety purposes;

(7) A simple method of test which will insure the detection of unreliable ground or earth connection;

(8) Economies which may be practiced with safety in connection with any of the existing wiring methods;

(9) Estimates or actual figures as to the cost of any protective features reported upon in response to the foregoing requests; and

(10) Any data or experience calculated to assist the committee in reaching an accurate conclusion relative to the practicability of bare, grounded return wiring systems.



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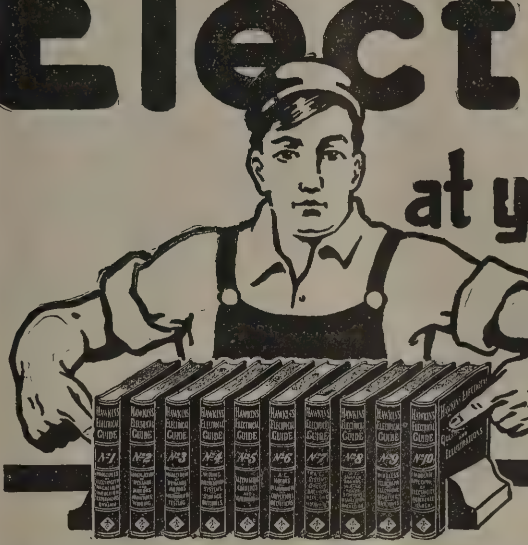

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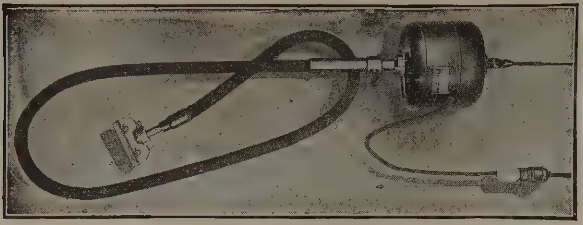

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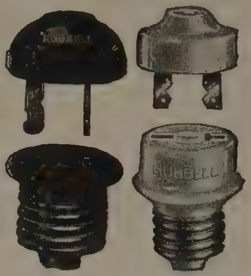
The French language is more easily understood over the telephone than the English language, provided you understand French.

Which brings to mind the conversation (in plain United States) between a gentleman from the West and his Eastern friend. Said the Westerner: "You can get juice at two cents per K.W. hour in Oshkosh." "Fine," rejoined the Easterner, "but who in hades wants to live in Oshkosh?"

A NEW FOOL-PROOF ATTACHMENT PLUG.

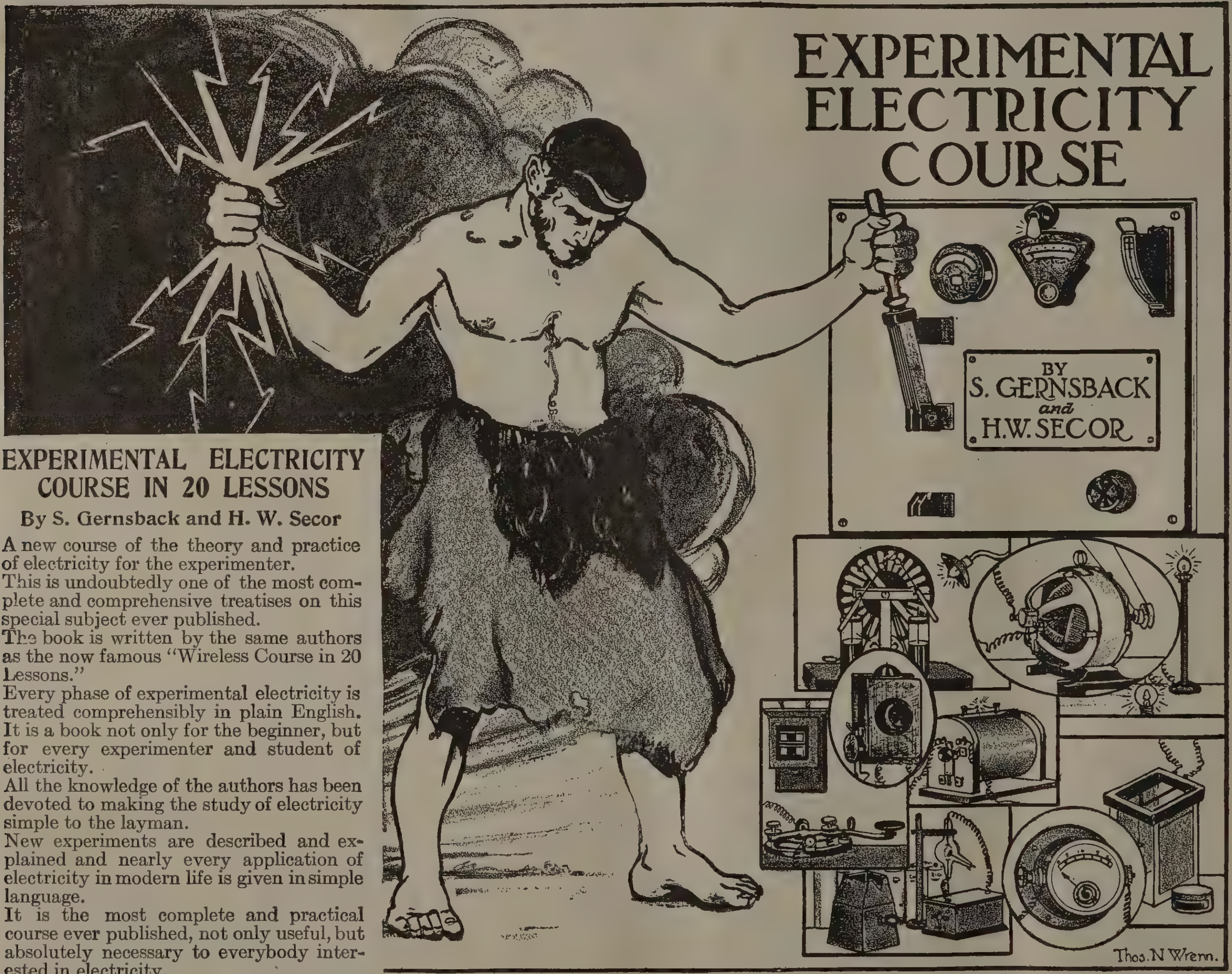
When direct current is used it is extremely important that the flow of current be always maintained in the same direction. With the increasing popularity of portable machines and tools the need of a convenient *polarized* separable attachment plug to assure correct polarity has been manifest. To meet this need a progressive manufacturer has just placed on the market a small separable attachment plug with such polarized contacts.



The slots in the base are placed at right angles and the knife blade contacts in the cap arranged to correspond. Using this plug it is impossible to reverse the polarity once it is established in the cap. It is made of a tough heat-proof composition with a nickel-plated screw shell, presenting a compact and pleasing appearance.

When charging small storage batteries, where an accidental current reversal would "kill" the battery, these new plugs are especially welcome.

Fourteen Trans-Atlantic submarine cables now connect America with European points.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THE "SIMPSON LIGHT" IN ELECTRO THERAPEUTICS.

Quite apart from any healing properties which it may possess, great interest attaches to the so-called "Simpson Light" with which work of a more or less experimental character has recently been carried out at St. Bartholomew's Hospital. The light was discovered owing to the fact that Mr. Simpson, who was making a research on the affinity of rare metals for each other noted that the electric combustion of certain ores produced a light having "creative effects on the workmen's hands." He produced an electric arc lamp with the ores as its electrodes.

In a contribution to the *Lancet* Drs. Harmer and Cumberbath, of St. Bartholomew's Hospital, recount briefly the nature of the rays produced and the therapeutic effects which they have obtained with the rays. The electrodes are made up of a mixture of the ores of certain metals, notably a tungstate of iron and manganese known as "wolfram." Two kinds of rays are produced, visible and invisible. The invisible rays are heat rays and ultra-violet rays. The ultra-violet rays are, of course, familiar enough, but the ultra-violet rays emitted by the Simpson lamp differ in some respects from those already obtained. Thus the Simpson lamp produces a more intense ultra-violet light than that given by a carbon arc lamp like the Finsen lamp. Professor Horton compared the lamp with lamps in which the electrodes were made of aluminum, zinc and cadmium, and found that, good as these metals are as sources of ultra-violet rays, the Simpson electrodes were better.

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The cost of electricity has decreased so much in the last ten years that it is now within the reach of the smallest wage earner, scientific housewives concede, that electrical equipment provides the most efficient tools to work with.

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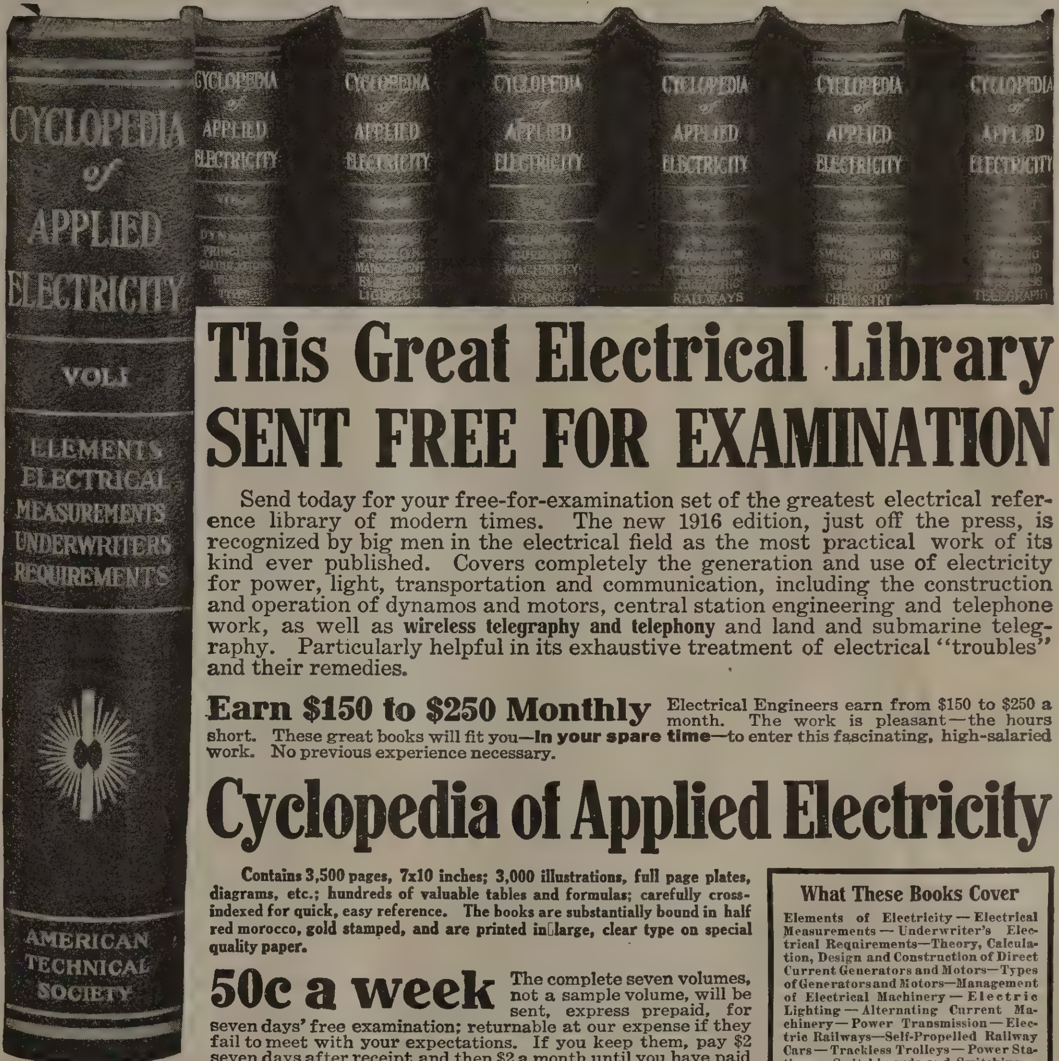

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BOOK REVIEW.

Wireless Transmission of Photographs, by Marcus J. Martin; 117 pages, 62 illustrations. Size, 8¾ by 5¾ inches, cloth bound. Published by The Wireless Press, Ltd., London, England. Price, $1.25.

Several articles have already appeared in *The Electrical Experimenter* on the wireless transmission of photographs. This work has not reached the stage of commercial development, but the laboratory work already done shows great possibilities for practical demonstration. In the first considerations, Mr. Martin discusses the commercial value of the apparatus, and gives an outline of the difficulties experienced in using the present transmisson systems.

In the chapter on transmission, details for several systems are given. One particularly simple set is described, suitable for experimental work. The different apparatus for receiving, such as the use of the Einthoven galvanometer, Blondel's oscillograph and the Cathode ray receiver are described. In connection with this apparatus, synchronizers and driving motors are also explained.

Selenium cells, while not used in most systems of transmission, are employed for some work. The chapter on these cells is one of the few which have been written on the subject and includes curves showing the inertia and recovery of the cells. The last chapter gives directions and suggestions to those who wish to experiment with the apparatus.

There are, however, several errors, among which may be mentioned the misspelling of "ammonium" and "D'Arsonval." One or two phenomena are not correctly explained, but this does not lower the value of the book to practical experimenters.

Thomas A. Edison, by Francis Wheeler. Cloth covers, 201 pages, 6 illustrations, 7x5 inches. Published by The Macmillan Co., New York City, N.Y. Price, 50c.

To those who are interested in experimental work, the story told in this book should be particularly interesting. Possibly no man has ever made as many experiments as Thomas A. Edison. From the time he squatted over the goose eggs to make them hatch, until the present epochal period, when he heads the United States Naval Advisory Board, Edison's career has been one long series of experiments. The story of the life of our greatest American inventor contains many inspiring suggestions for those who expect to carry on the work which Edison has so well started—that of making our nation not only up-to-date, but foremost in the scientific field.

His maxims and methods will surely help others who are now at the foot of the ladder which he has climbed.

Effect of Imperfect Dielectrics in the Field of a Radiotelegraphic Antenna. Scientific paper No. 269, Bureau of Standards, Washington, D.C. Prepared by John M. Miller, Assistant Physicist.

A valuable paper of interest to all radio men, covering the effect on the radiation resistance of an antenna occasioned by the proximity of neighboring insulating bodies or dielectrics. Curves are given illustrating the absorption effect produced on that portion of the leads, to an antenna, inside the building; absorption caused by the proximity of a tree, also radiation resistance curves for antennae located entirely within a building.

Engineering As a Career, consisting of 22 papers by prominent engineers, edited by F. H. Newell and C. E. Drayer. Cloth bound, 214 pages, 7½ by 5 inches. Published by D. Van Nostrand Co., New York City. Price, $1.00.

At this time many young men are preparing or intend to become "engineers." The ideas as to what an engineer really is, seem to be extremely hazy. Moreover, his teachers in the preparatory schools are hardly better informed. In this volume, twenty-two successful engineers give their opinions, as to the personal and educational requirements necessary for those who expect to take up engineering as a life work. Altogether, the future does not seem particularly bright, according to a table presented, which shows the amount of time an engineer can expect to be employed. The idea of giving his life to a work where the greatest remuneration is the satisfaction of being useful, will not appeal to everyone. This book will be helpful to professional advisers and parents who are helping their sons in the choice of a career.

If this work may be taken at its face value, it surely brings to light the fact that engineers, be they civil, electrical, chemical, ad lib, are certainly grossly underpaid, all things considered. No other profession is so misunderstood or undervalued as this one; a state of public opinion that some of our future technical men can undertake to change. The conditions in this respect are slowly changing for the better, even now. Undoubtedly a goodly part of this state of affairs is due to improper training of the students. It is an absolute fact, proven in actual practise many times over, that some of the college graduated engineers are only walking mathematical freaks. They can figure, yes, but they can make no practical application of their knowledge.

MANUAL OF WIRELESS TELEGRAPHY FOR NAVAL ELECTRICIANS. By Commander S. S. Robison, U.S.N. Canvas covers, 243 pages, 117 illustrations. Price, $1.50.

Like other standard government publications, this book covers its subject clearly, concisely and fully. The Navy Manual has been the hand-book of wireless operators for over thirteen years, following the advance of radio apparatus with frequent new editions. There is, however, very little difference between the new edition and the previous one. A page on the audion detector and amplifier is the principal addition. At the same time, we believe that many operators who have been working at wireless even for several years can learn much from this book. The appendix, covering the standard practice in message forms, if carefully followed, would do away with much of the needless interference which is now preventing serious experimental work in the cities, particularly operators desiring to enlist to go to either of the Navy wireless schools will find it to their advantage to become familiar with this book, as it is used as a textbook in the school.

ELECTRICAL ESTIMATING. By Harry B. Kanter, 52 pages; 1 specification and blue print, 11x8½ inches. Paper covers. Price, $3.00. Published by The Electric Estimator, New York City, N.Y.

To busy electrical contractors and electricians who do not care to wade through lengthy technical treatises on this important subject, the work by Mr. Kanter will particularly appeal. A typical set of electrical specifications for the wiring of a loft building and a large blue print showing the lay-out of the illumination circuits are included.

The author has laid particular stress on all of the practical estimating problems encountered by those bidding on electrical work, and has given a number of valuable tables showing in detail the complete estimates for various kinds of wiring, the proper figuring of labor cost, incidentals and profit. Some of the sections deal with the cost of trouble hunting jobs, the manner of figuring on the linear foot basis, and small wiring propositions, such as private residences, electric bell installations and motors.

HOW TO MAKE LOW PRESSURE TRANSFORMER. By Prof. F. E. Austin, B.S., E.E. 18 pages; illustrated; 7¼x4¾ inches. Cloth covers. Price, 40 cents. Published by the Author, Hanover, N.H.

For those who wish to design and construct low tension step-down transformers of the closed core type this book has been written. These transformers treated upon are for ringing bells, running toy motors, laboratory apparatus, electro cautery instruments, etc. Data are given for the specific design of a step-down transformer of small size, and also a table of directions for the connection of different winding divisions, so as to obtain any voltage as a secondary from 8 up to 64 volts. The directions cover the construction of the laminated iron core, and the winding of the primary and secondary coils. With the aid of this book one can readily learn how to properly design and build a step-down transformer for any requirements.

ELEMENTARY LESSONS IN ELECTRICITY AND MAGNETISM. By Silvanus P. Thompson, D.Sc., B.A., F.R.S., F.R.A.S., etc. Seventh edition, revised and enlarged. 700 pages; 377 illustrations; 8x5½ inches. Ribbed cloth binding. Price, $1.50. Published by the MacMillan Company, New York City, N.Y., 1915.

The seventh edition of this reliable and complete treatise covers the elementary and physical sides of electrical and magnetic problems.

The author is well known in scientific circles, and the value of this volume can be no better expressed than by stating that this is the seventh edition, which means that it must have more than ordinary merits. Those who have perused the first editions will be agreeably surprised to find that the new volume has been completely revised and brought up to date. One of the new chapters deals with electric waves and oscillations, with special reference to their bearing on radio telegraphy. There is also a chapter on this particular subject. Chapter 27 deals with the modern aspects of the electron theory of electricity. Radio activity is covered at some length, as well as photo-electric phenomena, and the principal effects in magneto optics.

It is difficult to give credit, in the space of an ordinary book review, to all of the multifarious subjects with which this book treats, but suffice it to say that practically all of the scientific apparatus used in the electrical art are taken up.

The author, as many of our readers know, is one of the leading authorities in electrical science, but some students and engineers will take issue with him on the methods of treating several of the subjects in this pretentious volume. However, in the main, the text adheres closely to the accepted standards of electrical engineering as we understand it to-day. Students will find this work

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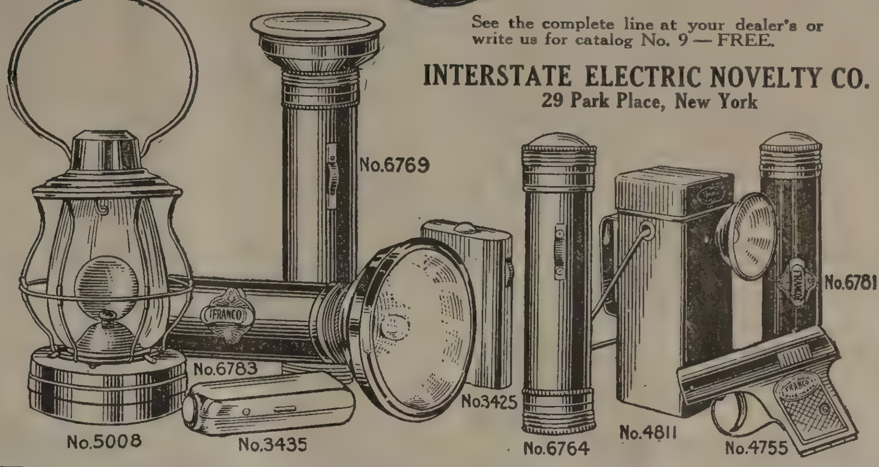

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particularly valuable, as there are so many unusual topics discussed which are ignored in some of the American text-books, such as effects of the earth's magnetic field on compass needles, various forms of galvanometers and their equations, the action of permanent and electro-magnets at various distances from each other, and the method of computing the resultant forces. It is doubtful if there is another work covering the subject of magnetism as thoroughly as does this one. This also holds true for the section on static electricity, which includes thunderstorm phenomena. This valuable book will be extensively used in the future, as in the reviewer's opinion there is not another work at the present time that can duplicate this one by Dr. Thompson, volume for volume.

EXAMPLES IN ALTERNATING CURRENTS, VOL. I. By Prof. F. E. Austin, B.S., E.E. 224 pages; 70 illustrations; 7¾x4¾ inches. Flexible leather covers. Price, $2.40. Published by the author, Hanover, N.H., 1915.

This is a somewhat different treatment of the subjects included in the study of alternating currents and their practical applications in engineering practice.

This work by Prof. Austin contains examples worked out, together with all necessary mathematical formulae for the determination of current and voltage relations in practically any type of circuit, including those where inductance or capacity predominate; also circuits containing both of these quantities, as well as resistance. A number of original graphic curves are given, showing the phase relations with the different circuit conditions; also how various harmonics combine to give a certain shape of resultant wave form.

The book is quite complete, and the practical man, college student, and expert will find some interesting reading in it. The author has made use of calculus where necessary, and has endeavored to treat the subject in as thorough a manner as possible.

Numerous tables are given which will prove of inestimable value to those working with alternating current functions. Also some valuable formulae and direct measurement methods for determining the value of self-inductance of magnetic windings, containing iron cores or plain windings without cores. Those interested in radio work will find this book of particular value in many respects. The quantities in complex alternating current circuits containing series-parallel arrangements of inductance and capacity are also discussed and explained. The wording of the book is clear-cut and to the point.

OUR INVENTORS.

There were fifty epoch-making inventions during the past fifty years. That is the way the scientists have figured it out—fifty of them in fifty years.

Of this number, thirty-six are credited to citizens of the United States, while all of the rest of the world has contributed but fourteen of these great discoveries or inventions.

The first ten of the American inventions are given as the telephone, typewriter, cash register, incandescent lamp, talking machine, electric furnace reduction, electrolytic alkali production, transparent photograph film, motion picture machine and buttonhole sewing machine. The first ten of the foreign inventions are given as electric steel, dynamite, artificial dye, siphon recorder, gas engine, wireless telegraphy, smokeless powder, Diesel oil motor, centrifugal creamer and manganese steel.

There may be a difference of opinion as to the relative merits of the inventions; indeed, there will be hardly any two persons who will agree as to the relative importance of the American inventions, much less with the foreign ones. But the fact remains that the world recognizes that we in this country have given to the world thirty-six inventions of tremendous importance, while the rest of the world was giving it but fourteen.

SILVANUS P. THOMPSON, FAMOUS SCIENTIST, DIES.

The death of Silvanus Phillips Thompson, the English savant, on June thirteenth, is a great loss, not only to his personal friends, but those in the electrical profession as well. His pupils and admirers in America and Europe can testify to his success as a teacher. He exercised considerable influence in electrical engineering literature, which commanded for him great respect among electrical engineers. He was at first a teacher of physics, particularly of optics and electricity, but later he gave his attention to dynamo-electric design. He wrote a number of text-books, which from the first were engineering classics. As principal of the Finsbury Technical Institute since 1885, he was able to impart to his student his stimulating influence, which they carried to all parts of the world. As past-president of the Institute of Electrical Engineers and of the British Committee of the International Electro-Technical Commission, he was recognized as the dean of the British electrical engineering profession. He was one of the earliest advocates of electrical power transmission, and did much to hasten the adoption of distributing systems.

He held among other titles those of Bachelor of Arts and Doctor of Philosophy, besides being a fellow of the Royal Society and a fellow of the Royal Astronomical Society.

Beside his work in electricity, he made many contributions to science and philosophy. Many of his papers were excellent examples of scientific English, characterized by a remarkable lucidity and directness of style. He also painted and loved works of art. Whole-hearted, earnest and devoted to the work of developing the science of electricity, he will be remembered and respected everywhere as a pioneer in his favorite art.

TO FLOOD LIGHT NIAGARA FALLS.

The City Council of Niagara Falls, N.Y., has authorized an expenditure of $10,000 for the illumination of Niagara Falls. The money is to be devoted to carry out the flood-lighting scheme submitted by the American Lighting Company, Chicago. For some weeks Will J. Davis, president of the company and inventor of the flood-lighting system of the American Lighting Company, has been making arrangements to illuminate the Falls, and for several nights previous to the action of the City Council a battery of twenty-five flood lights was turned on the American Falls and the rapids of the Niagara River.

The effect created was so far beyond the expectations of the promoters of the project that the expenditure was enthusiastically approved, and it is now planned to double the number of lamps in service and from time to time to add to the battery as new lighting effects are desired.

Paul A. Schoellkopf, commissioner of the Niagara State Reservation, is particularly enthusiastic over the demonstration, and it is due to his efforts in great measure that the City Council has taken such definite action with regard to the illuminating scheme. Mr. Schoellkopf has expressed the belief that the illumination of the Falls will insure the stopping over in Niagara Falls, N.Y., of many transients who would otherwise remain only for a few hours during the day. It is proposed to light only the American Falls, making it a purely American proposition. Mr. Schoellkopf has tendered the services of the employees of the Hydraulic Power Company free of charge to the city, and it is understood that the Niagara Falls Power Company is to donate the power necessary to operate the lights.

With the flood-lighting system employed there is no dark center or wings in the light-beam, and the Falls are smoothly and softly lighted. The beam is powerful enough to penetrate the densest parts of the rolling mist, and owing to the intensity of the flood lighting the entire illuminating scheme is carried out on a very economical expenditure for energy.

HOW THEY "KIDDED" McGINNIS ON LONG DISTANCE.

"Hello, Winnemucca, is that you, Mr. Twist? How are you, Mr. Wire Chief? This is Mr. Carty."

"Yes, Mr. Carty. What can I do for you?"

"We're having a dinner here in New York—3,000 of us telephone folk—and there are 3,200 more of us in Philadelphia, Baltimore and San Francisco, all hooked up on the transcontinental line. Can't you cut in somebody out there and let us talk to them?"

"Wait a minute and I'll see (Twist, out in Nevada, quiet for ten seconds). Hello, Mr. Carty, here's McGinnis, foreman of No. 6 construction gang. He's in his shack about forty miles out in the Mojave Desert."

"Hello, McGinnis. This is Mr. J. J. Carty of the telephone company. I'm in New York at dinner and thought I'd have a little talk with you."

"Say, Twist, who d'ye think yer kiddin'? Why can't ye let a man rest?"

"Really, McGinnis, this is Carty, in New York. I want you to talk to about six thousand men at once. They're all eating chicken and sweet potatoes and ice cream while they are listening to you."

"Carty, hell! If you don't get off the line, Twist, and stop stringin' me, I'll—"

"On the level, McGinnis, it is really Mr. Carty talking. Be good now. How is the weather out there in the desert? Fine, isn't it?"

"Rotten, ye mean. The thermometer blew up a week ago and it's 107 at this minute, an' the sun set half an hour ago. If ye are Carty, sure enough I'm sorry I was impudent, sir. If ye could shoot along some of that chicken an' ice cream, it would be a godsend to us poor devils."

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Among others, this book contains the following important apparatus: How-to-Make an Experimental Arc Set, How-to-Make a Speaking Arc Light, How-to-Make a Quenched Spark Gap, How-to-Make a ¼ K. W. Transformer, How-to-Make an Oscillation Transformer, How-to-Make a Radio Break in System, How-to-Make a Photophone, How-to-Make a Rotary Spark Gap, How-to-Make an Independent Vibrator, How-to-Make a Calibrated Spark Gap, and many others.

Size of the book is 7 x 5 inches, substantially bound in paper; the cover being printed in two colors. There are 100 pages and 88 illustrations. There are quite a few full-page illustrations giving all dimensions as well as photographs showing finished apparatus.

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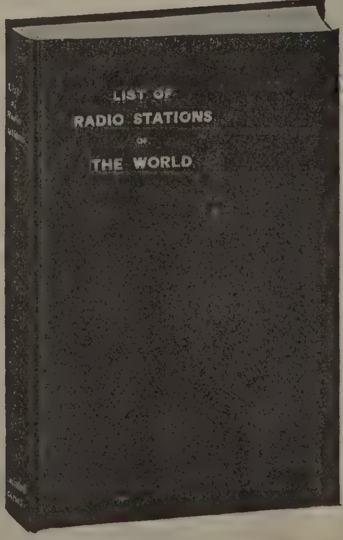

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EXPERIMENTAL CHEMISTRY.

(*Continued from page 265*)

Place the folded paper in a glass funnel, open it, giving three folds on one side and so that the paper is pressed firmly against the sides of the funnel, then wet the paper thoroughly. Now pour the sugar solution obtained in Experiment No. 5 into the funnel and catch the liquid which passes through (the *Filtrate*), in a clean test tube or beaker (see Figs. 10-A and B). Taste a drop of the liquid which passed through the filter paper (the *Filtrate*) and notice that it still has the same sweet taste as before it was filtered. This would indicate that the sugar was in solution.

The liquid which passed through the filter paper is called the *Filtrate*, and if anything is left on the filter paper it is called the *Residue*.

A home-made automatic Filtering apparatus can be constructed as shown in Fig. 10-B. This apparatus is intended to minimize the time and trouble always attached to the process of filtration. When large quantities of a liquid have to be filtered, it becomes tiresome to stand over a funnel and wait for it to empty, only to fill it again, repeating this process over and over until the liquid is thoroughly filtered. As the name implies, this apparatus is automatic, in that all that is necessary to do is to fill and adjust it and it will filter as much liquid as necessary without any further attention.

Make a back [A] of seasoned wood 12x6x½ inches. Plane down, sandpaper and shellac. The base is made of the same wood, 8x6x½ inches, finished in the same manner as the back.

The upper support [B] is made 4x4x½ inches and is fastened securely to the back. A "V"-shaped hole is drilled through the center, so that different size bottles may be accommodated.

The adjustable support [C] is made the same as B. Drill a hole in the center in the same manner as B and fit a funnel into this hole. This support is held to the back by means of round wooden pegs as shown by C in the illustration.

As the illustration clearly shows, the upper bottle is fitted with a one-hole rubber stopper, through which passes a piece of glass tubing. This glass tubing extends to the middle, or a little below the middle of the funnel. When this funnel is filled with a liquid, the liquid from the upper bottle will not flow, due to the lack of atmospheric pressure. As soon as the liquid has passed through the filter paper and the opening of the tube allows enough air into the bottle, the liquid will again fill up the funnel and so on till the liquid has been all filtered.

If the whole apparatus is sandpapered and given a coat or two of shellac, it will be found to be a very neat and serviceable accessory to any laboratory.

I have cut the top of a ½ gallon water bottle off and instead of removing to fill the top bottle all the time, just pour the liquid in the bottle. Of course this method requires the continual cleaning of the bottle, after each use, but I find it much more convenient, as it eliminates the removal of the stopper, the replacing of the bottle, and necessary adjustments each time the bottle is filled.

Experiment No. 7—

Pour a few drops of dilute Sulphuric acid [H_2SO_4] into about 10 c.c. of the liquid obtained in Experiment No. 5. Notice the difference in color, temperature of the tube and change from liquid to solid, also the odor of the gases given off.

All these indicate a chemical change. Instead of a clear liquid, there is a black mass looking very much like charcoal. After the addition of the H_2SO_4 the black mass tended to rise in the tube, due to the escape of the gases into the atmosphere.

The Sulphuric acid used here is called a *Reagent*, which is a substance producing a reaction, or *Chemical Change*.

Experiment No. 8—

Mix 7 grams of powdered (or reduced) iron (Fe) and 4 grams of Flowers of Sulphur (S) intimately by putting both in a mortar and mixing with the pestle. After the two elements are mixed thoroughly, take a little of the mixture and place on a piece of white paper. Next, by passing a magnet UNDER the paper which contains the mixture, see if you can separate the iron from the sulphur. This can be effected very readily.

Experiment No. 9—

Take the mixture obtained in Experiment No. 8 and pour into a dry test tube. Do not have the tube more than one-quarter full. By means of a test tube holder hold the tube containing the mixture in the flame of the Bunsen burner, as shown in Fig. 12. Keep the tube in constant motion and hold it in the hottest part of the flame until you notice a distinct reddish glow spread through the entire mixture. (Any flame in the tube is due to an excess of sulphur and need not be bothered with.)

When the tube is still hot, let a drop or two of water fall on the lower part of the tube, thereby cracking it. Break the tube by striking the cracked portion on your asbestos pad. Try and separate the Fe and S by means of a magnet as in Experiment No. 8. Notice the difference in properties of the substance obtained, than that of the original iron and sulphur mixture. This Experiment illustrates *Synthesis*.

In Experiment No. 8, when we mixed the iron and sulphur together, we found that by passing a magnet under a piece of paper containing the mixture we could cause the iron powder to be attracted by the magnet, thereby separating the Iron from the Sulphur, showing that the Fe and S were merely in a state of *Physical Mixture*.

We could still see the separate elements, i.e., the iron and sulphur. If this were a chemical compound this could not be done.

In Experiment No. 9 we find that a magnet has no effect whatsoever upon the compound obtained. The iron and sulphur are still present, but in an entirely different form, namely Ferrous Sulphide (FeS). The following equation represents the chemical reaction which took place:—

$$\underset{\text{[iron]}}{Fe} + \underset{\text{[Sulphur]}}{S} = \underset{\text{(Ferrous Sulphide)}}{FeS}$$

This process of building up a compound from its elements is called *Synthesis*. In this case Fe and S were the elements employed to build up the compound FeS.

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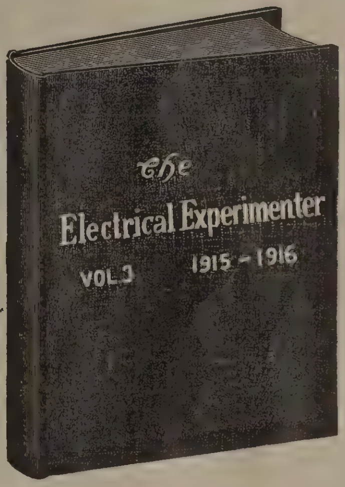

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FOR SALE OR TRADE—10-inch induction coil, $30. Electrolytic interrupter (new), $2. Crystaloi resonator (new), $2. Large motor rheostat, $4. Ralph Leffler, Tiffin, Ohio.

NOTICE—No. 2 Folding Brownie camera, tripod and portrait attachment, $5. Guitar, $3.50. Coupler, 75c. 20 Ohm sounder, 50c. Sell or trade for wireless instruments. Francis H. Ransford, Dalton, Mass.

ALL KINDS of wireless apparatus for sale, audion receiving set (cabinet type), sending transformer, motors, aerials, storage batteries, 2 complete smaller sets (mounted) wire, knobs, insulators, receivers, switches, etc. Write for complete information and prices. C. H. Neely, 726 Elk St., Franklin, Pa.

MODERN necessity for sharpe waves—mahogany aerial loading inductance, made by Chambers of Philadelphia, wound with 10 turns No. 6 brass wire. Will trade for rotary variable condensers or what have you? Eben W. Erikson, Winnetka, Ill.

FOR SALE—E.I. Co transatlantic phones, like new, $4. E.I. Co. rotary variable condenser, $2. Duck's ferron detector, $3. Gernsback electrolytic interrupter, $1. No. 6 Ansco camera and case, as new, $10. Winchester automatic No. 12 shotgun and case, cost $35, $17. J. Methven, Box 171, Ronald, Wash.

HOW'S THIS?—Navy coupler, $3; 6-80 storage plates, $2; new ¼ mounted "Blitzen" transformer, $10.00; aerial switch, $1.00; key, $1.10; new Holtzer-Cabot phones, $7.00; new Thordarson transformer, 1 K.W. with protective resistances, $23.00, never used; 2 in. coil, $5.00, and other radio apparatus. Write for list. C. R. Barnickol, 2317 Milwaukee Ave., Chicago, Ill.

FOR SALE—3-inch coil, ¼ K.W. condenser, ¼ K.W. fixed spark gap, 150 watt step down transformer, 2 fixed receiving condensers, variable condenser, Crystaloi, silicon and Galena detectors, 3 large loading coils and a quantity of very sensitive galena. Instruments are in excellent condition. Write for prices and description of instrument you need. Cecil Bridges, Louisville, Ill.

COMPLETE ½ K.W. transmitter and receiver. All accessories including aerial suitable for commercial purposes. Address G. E. McGinitie, Bandon, Ore.

WANTED—Following Clapp Eastham goods: One kilowatt Hytone transmitter; one kilowatt Type E transformer. Must be in perfect condition. B. W. Nestlerode, Y.M.C.A., Sioux City, Ia.

FOR SALE—1 ½ spark coil, $3.50; tape printing telegraph learner, $2.50; adjustable sending condenser, $1.75; Interstate receiving outfit, $2.50; telegraph key, 50c; No. 2 Brownie camera, $1.50; spark balls, 50c; hypnotism course, $3.00. All in good condition. M. Lahita, 1625 Hartzel Ave., Youngstown, Ohio.

FOR SALE—National automatic transmitter (Morse), $10. Harold Bonney, Louisville, Ill.

FOR SALE—Home-made receiving outfit consisting of Navy type receiving transformer, primary 250 turns with one turn variation, switch points used on both primary and secondary, secondary 10 points, two rotary variable condensers, 1 adjustable fixed condenser, galena and silicon detectors and buzzer test. Make offer. Ernest S. Bancroft, Kennett Square, Pennsylvaania.

WANTED—Ford auto parts, discarded, etc., cheap or will trade. Write Clyde Ayers, 726 Lavette St., Benton Harbor, Mich.

FOR SALE—A lot of wireless and electrical apparatus at great bargains. Must sell at once; all new. John A. Irvin, Cannelton, Ind.

BARGAINS—In wireless and electrical apparatus. A supply of electrose insulators. Must sell. Send at once for big list John A. Irvin, Cannelton, Ind.

FOR SALE—3x5 press with a big complete outfit. Cost $25.50; will sell for $18. Thomas Higgins, 112 Adeline St., New Haven, Conn.

WILL SACRIFICE "Interstate" receiving outfit, antenium wire (450 feet), 10 electr. insulators, ground clamp, 1 ounce Galena, junior fixed condenser, Galena detector, all new, never used, $5. Cost, $7.65; might trade. Geo. Bellamy, Main St., Plymouth, Pa.

I HAVE aerial wire, detectors, books, flashlights, sporting goods and many other things for sale. Write for list and prices. George Sharp, 73 Everett Ave., Providence, R.I.

FOR SALE—Three ⅛ horse-power 110 volt D.C. motors, will run as generators, $4.50 each. Also have a Temple 1¾ horse-power hopper cooled gasoline engine, $20. Will trade on charging generator and 16 inch A.C. oscillating fan. B. J. Hospes, 1907 S. Turner Ave., Chicago, Ill.

FOR SALE—Three sections moulded condenser, $4.00. Hot wire ammeter, $2.25. Kickback preventer, $1.25. Audion bulb. Will take variable in exchange. Max Kuhne, 94 River St., Hoboken, N.J.

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Mattoon, Ill., June 26, 1916

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WILL SWAP one-half H.P. gasoline engine for wireless apparatus or sell cheap. Write H. Griffin, Hartselle, Ala.

FOR SALE—1 inch spark coil, gives 1½ inch and helix, $2.00. Good condition. Raymond Phelps, Caro, Mich.

FOR SALE—One complete ½ kilowatt sending and receiving station in A1 condition, receives up to 6000 meters, sends 60 miles, $29.30. Write for particulars. Spyker A. Kurtz, Mifflinburg Pa.

BARGAINS—E. I. Co. goods; loader, $1.75; helix, $1.15; wireless course, 35c.; 1½ inch spark coil, primary and secondary, $2.25; ½ inch coil, $1.25. W. C. Kohl, 75 Richardson Road, Melrose Highlands, Mass.

HAVE 1 25-35 Winchester rifle, fully guaranteed, cost $17.00, will sell for $13.50. Also 1 baseball bat, two gloves, an automatic screw driver. Will trade these for electrical books. Write John A. Kerr, Larkspur, Colo.

CASH PAID for Selenium cell, Microphone and vacuum coherer. Must be in good condition, or what do you want in exchange? F. A. Steinbrook, Brookville, Pa.

FOR SALE OR TRADE—13 H.P. 220 volt D.C. motor, ½ K.W. generator, 1 typewriter (Hammond), ⅛-inch D.C. fan, two 2 inch spark coils. I want sending transformer, helix, condenser, rotary spark gap, receiving transformer, Arnold's or Clapp-Eastham type audion detector. What have you? All letters answered with 2c. stamp enclosed. Philip Mueller, 209 2d St., La-Salle, Ill.

SPECIAL SALE—Radio receivers, see ad. opportunity exchange on following page and save money. D. E. Rivers, Harvey, Ill.

FOLDING CAMERAS and outfits, tennis racket. Have all kinds of wireless instruments, bicycle supplies and good as new $10 violin. Dean Wilson, Alpha, Ill.

FOR TRADE—Small wood lathe with tools, also heliograph. Want wireless instruments, as transformer receivers. E. P. Hunt, Orrick, Mo.

WANTED—10,000 meter coupler, variable condensers, audion, receivers, etc. Cash or will exchange 10 inch X-Ray coil. Frank Ward, 110 Vernon Ave., Brooklyn, N.Y.

WANTED—Good omnigraph or tape transmitter. Also burnt out audion detector bulbs or audion amplifier bulbs. Carroll Pfleegor, Milton, Pa.

FOR SALE—Lathe, 2 inch swing, 14 inch between centers made of brass and steel, bargain $10. Wilhelm Kuhne, 94 River St., Hoboken, N.J.

FOR SALE—E. I. Co. loading coil, fixed variable condensers, rotary potentiometer, radioson detector, aerial switch. Also have home-made coupler and $40 bicycle. Park V. Arnold, Prattsburgh, N.Y.

WANTED—Thordarson rotary gap, variable condensers, audiotron. Have wireless apparatus. A. R. Bentley, 42 Hill St., New Bedford, Mass.

BARGAIN—Two Crystaloi detectors, type AA and O, good as new. Am getting audion. Clinch, Lakewood, N.J.

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BARGAINS—Wireless course, $1.75; ohm receiver, 25c.; automobile course, $3.00; illustrating course, $5.00; violin making course, $1.50; 32 calibre reloading tool, $1.00; violin, $15.00. D. C. Kurtz, Johnstown, Pa.

NEW No. 6 Seneca Folding Camera, 5x7, 2 plate holders, tripod, case, 1 dozen new plates, cost $22.75, best offer around $15.00 takes all. Will consider two new sections Murdock moulded condenser, 2 inch spark coil in part trade. Donald Baumgardner, Demster, N.Y.

FOR SALE—Blitzen type oscillation transformer, $5.00; $8.00 2000 ohm headset, $4.75; Murdock, $5.00; variable, $3.00; 15 plate variable, 80c.; 2500 meter loader, $1.25; three telephone transmitters, 70c. each; two telephone receivers, 45c. each; Baldwin camp light, 70c.; moving picture machine with film, $2.00. Robt C. Bishop, 413 Locust St., Lockport, N.Y.

AUDION. AUDIOTRON. AMPLIFIER bulbs, for sale or exchange for good typewriter and variables. Enclose stamp. Woodcock, 496 W. Ferry St., Buffalo, N.Y.

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SELL OR TRADE MOTORS—K.&D. No. 5, $5.00; No. 4, $2.50; New Departure, 75c.; 110 V. 1/12 H.P. D.C., $2.50; Universal Detector, 75c.; Crystaloi (new), $2.75; loose coupler, $1.00; 6-60 Witherbee batteries, $8.00; 2 telegraph sets, both $2.25; ½ inch coil (good), $1.00. Albert Heyman, 227 S. 20th Ave., Minneapolis, Minn.

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FOR SALE—Long distance Audion set, $25; numerous other wireless instruments. One horse-power alternating current motor, 110 volts, 60 cycles, $25.00. Herman Staab, Ironton, Ohio.

EXCHANGE—Electro ½ K.W. transformer coil with vibrator for good receiving set. Caesar Porcari, 566 Herkimer St., Brooklyn, New York.

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9 AEE has one New Tel-Radion for $4.40; three new Electron-Audio bulbs at $4.95 prepaid. Brandes Phones, $4.00. Want all used apparatus. Address Mattoon, Ill.

EXCHANGE 5x7 Camera, R.R. lens, two plate holders, leather case, for 6 V. 60 ampere storage battery. Sell 5x7 Camera, anastigmat lens, six plate holders, leather case, film pack adapter, $14.00; Modern Electrics, June, 1910; February, 1913; 11 latest Experimenters. Hofmann, 436 West 29th St., New York.

WANT motorcycle or attachment. Have 3000 mile receiving set, value $25.00. Schwarzburg, 1019 Kentucky St., Quincy, Ill.

LOOK!—Blitzen ¼ K.W. mounted, $7.00; two sections Murdock, $1.00 each; Essankay rotary, $2.50. Uriel Myers, Charleston, Mo.

FOR SALE—$28.00 Blitzen Receiving Cabinet, complete, with loading coil and switch wired to set. Used four months. Want $20.00. Hale G. Smith, Osage, Iowa.

SEND for my price list of couplers, detectors, and other apparatus. Surprising values. Can supply raw materials and parts. S. Place, 622 Stanbridge Street, Norristown, Pa.

FOR SALE—Six inch spark coil, fine condition. Worth twice price asked. If interested write A. W. Ward, 2 Columbia St., Brockton, Mass.

FOR SALE—Wm. Duck transmitting and receiving outfit D20, 300-900 miles receiving, 6-9 for sending, $21. Interested parties write Homer D. White, Box 5, Manilla, Iowa.

FOR SALE OR EXCHANGE—220 V. D.C. Fan, $5; No. 5 American Model Builder, $3.50; 3A Ansco Camera, $4.25; 2 volumes each Popular Mechanics, World's Advance. Other books. Want wireless. Make offer. John Buchanan, Groesback, Tex.

SALE OR EXCHANGE—Stamp collection, album, Catalog; 6000 stamps; 2000 different, 500 unused. Catalog value $65.00, sell for $15.00. Want wireless. John Buchanan, Groesbeck, Texas.

FOR SALE—Pair E. I. Co. 3000 ohm Government Phones, cost $7.75, sell for $5.50. Nicholas Electric Co. Navy Type loose coupler, cost $10.00, sell for $6.50. Chas. Davidson, Statesville, N.C.

EXCHANGE—Good 3500 meter navy type loose coupler for two variable condensers. Chester Ulsh, 451 Summit St., Marion, Ohio.

FOR SALE—R. J. 4 Detector, cost $18.00; one amplifier coil, cost $11.00; one Clapp-Eastham De Luxe Tuner, cost $25.00. Want omnigraph, loud speaking horn, binoculars or what have you? R. M. Horr, Lemmon, S.D.

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$200 AUDION detector-amplifier, $50.00. Bargain. Horton, 811 Halsey St., Brooklyn, N.Y.

FOR SALE—Large stamp collection in album. Catalog value $101.00, price $22.50 f.o.b. Richford. First check takes it. Benjamin Read, Richford, Vt.

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AA CRYSTALOI $4.00—Superior 'phones, $3.00; Electro Loader, $2.00. All new. Wm. Manley, Fall River, Mass.

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WANTED—One cylinder motorcycle engine from 3 to 5 H.P. in perfect running order. If you have one to trade write me immediately. Donald Taylor, Rivermont Ave., Lynchburg, Va.

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FOR SALE OR EXCHANGE—About 50 different articles, electrical, musical instruments, kodaks, pistols, etc. Write for list at once. F. J. Bretzke, Brownsville, Wis.

TRICKS—250 of them, for 10c. per copy postpaid. Joseph Brooks, 2722 West 47th St., Chicago.

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JOHN M. McLACHLEN, attorney-at-law—Patent causes. Union Trust Bldg., Washington, D.C.

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IDEAS WANTED—Manufacturers are writing for patents procured through me; 3 books with list of hundreds of inventions wanted sent free; I help you market your invention; advice free. R. B. Owen, 130 Owen Bldg., Washington, D.C.

WIRELESS

TOY TRANSFORMERS—A few left, $1.60; send for folders. A. R. Darling, 1532 N. Capitol Ave., Indianapolis, Ind.

SPECIAL SALE—Stromberg-Carlson Radio head sets No. A9723 2000 ohms, retail at $8.25, special $7.00; Holtzer-Cabot Radio head sets No. 84-202D 3000 ohms now retail at $8.80; 10% advanced was $8.00, special $7.50. Will supply these receivers in any number. The two foremost in the Radio field. All brand new and guaranteed. *Take this opportunity to save.* Postage paid. D. E. Rivers, Harvey, Ill.

$12.00 ROTARY GAP—Hardly used—in excellent condition, $10.00. Four section condensers each $4.00. Other bargains. Dilworth, 6121 Jackson St., Pittsburgh, Pa.

TESTED SILICON, 10c. oz. Gress, Pitman, N.J.

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125 MI DETECTOR, 20c.—Circular 2c. Patch Bros., Wireless Co., Klemme, Iowa.

FOR SALE OR EXCHANGE—5,000 meter loader, taped, step down transformer, 1 inch coil, 2 slide tuner, other apparatus. Send your list. Oscar Rasmuson, 135 Beach St., Jersey City, N.J.

WHO'S THAT CALLING? Get a copy of "Radio Stations of the World," a book that gives name, location and classification of every wireless station in the world. Price 35c. with postage on 1 lb. extra. Experimenter Pub. Co., 233 Fulton St., New York City.

FULL BLUE-PRINTS of loose-coupler described in August 1915 issue of The Electrical Experimenter. Price ten cents each postpaid. Experimenter Publishing Company, 233 Fulton St., N.Y.

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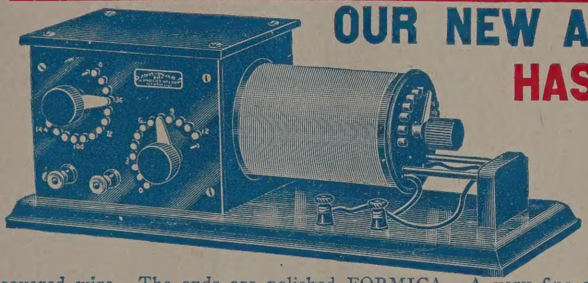

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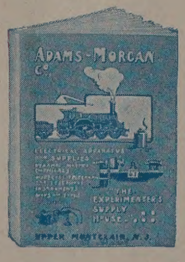

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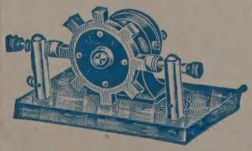

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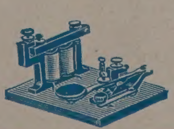

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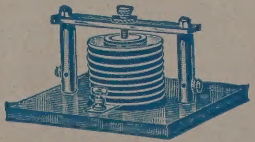

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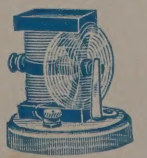

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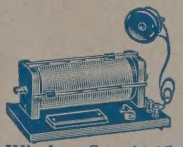

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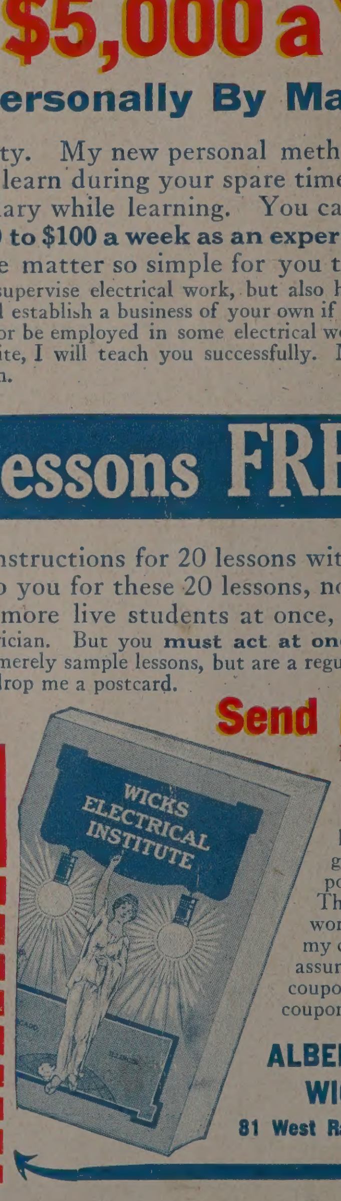

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